ABB Drives

User's Manual
DeviceNet Adapter Module
FDNA-01

DeviceNet Adapter Module
FDNA-01

User's Manual

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Safety instructions

Overview

This chapter states the general safety instructions that must be followed when installing and operating the FDNA-01 DeviceNet Adapter module.

The material in this chapter must be studied before attempting any work on, or with, the unit.

In addition to the safety instructions given below, read the complete safety instructions of the specific drive you are working on.

General safety instructions

WARNING! All electrical installation and maintenance work on the drive should be carried out by qualified electricians.

The drive and adjoining equipment must be properly earthed.

Do not attempt any work on a powered drive. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before working on the frequency converter, the motor or the motor cable. It is good practice to check (with a voltage indicating instrument) that the drive is in fact discharged before beginning work.

The motor cable terminals of the drive are at a dangerously high voltage when mains power is applied, regardless of motor operation.

There can be dangerous voltages inside the drive from external control circuits even when the drive mains power is shut off. Exercise appropriate care when working on the unit. Neglecting these instructions can cause physical injury or death.

Table of contents

Introduction

Intended audience

The manual is intended for people responsible for installing, commissioning and using an FDNA-01 DeviceNet Adapter module. The reader is expected to have a basic knowledge of electrical fundamentals, electrical wiring practices and how to operate the drive.

Before you start

It is assumed that the drive is installed and ready to operate before starting the installation of the extension module.

In addition to conventional installation tools, have the drive manuals available during the installation as they contain important information not included in this manual. The drive manuals are referred to at various points of this document.

What this manual contains

This manual contains information on the wiring, configuration and use of the FDNA-01 DeviceNet Adapter module.

Safety instructions are featured in the first few pages of this manual.

Overview contains short descriptions of the DeviceNet protocol and the FDNA-01 DeviceNet Adapter module, and a delivery checklist.

Quick start-up guide contains a short description of how to set up the FDNA-01 DeviceNet Adapter module using the ACS350 drive as an example.

Mechanical installation contains placing and mounting instructions for the module.

Electrical installation contains wiring, bus termination and earthing instructions.

Drive configuration explains how to program the drive before the communication through the adapter module can be started.

Master configuration explains how to program the DeviceNet master before communication through the adapter module can be started.

Communication profiles describes the communication profiles used in the communication between the DeviceNet network, the FDNA-01 module and the drive.

Communication contains a description of the DeviceNet functionality supported by the FDNA-01.

Diagnostics explains how to trace faults with the status LEDs on the FDNA-01 module.

Definitions and abbreviations explains definitions and abbreviations concerning the DeviceNet protocol family.

Technical data contains information on physical dimensions, configurable settings and connectors of the module and a specification of the DeviceNet link.

Further Information

Further information on the DeviceNet protocol is available on the world wide web from www.odva.org.

Overview

Overview

This chapter contains a short description of the DeviceNet standard and the FDNA-01 Adapter module, and a delivery checklist.

DeviceNet standard

The DeviceNet network has a linear bus topology. Terminating resistors are required on each end of the trunk line. Drop lines as long as 6 metres (20 feet) each are permitted, allowing one or more nodes to be attached. DeviceNet allows branching structures only on drop lines. An example of an allowable topology is shown in Figure 1.

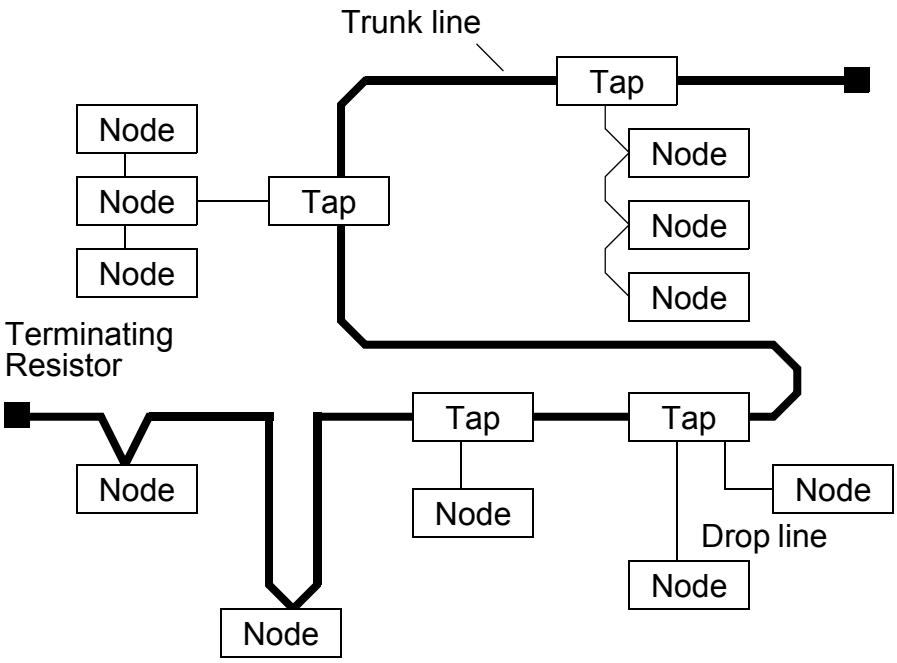


Figure 1. DeviceNet bus topology

The maximum length of trunk cable depends on the data rate and on the type of the cable used (see chapter *Technical data*).

Terminating resistor

The DeviceNet network should be terminated at both ends of the trunk cable with a 121 Ω, ¼ W, 1% Metal Film resistor. Connect this resistor between the two signal wires (CAN_H, CAN_L) on the DeviceNet cable.

The FDNA-01 DeviceNet Adapter module

The FDNA-01 DeviceNet Adapter module is an optional device for ABB drives which enables the connection of the drive to a DeviceNet network. The drive is considered as a slave in the DeviceNet network. Through the FDNA-01 DeviceNet Adapter module it is possible to:

- give control commands to the drive (Start, Stop, Run enable, etc.)
- feed a motor speed or torque reference to the drive
- give a process actual value or a process reference to the PID controller of the drive
- read status information and actual values from the drive
- change drive parameter values
- reset a drive fault.

The FDNA-01 acts as a Class 2 slave only with predefined master-slave connection set services. These include the Explicit Messaging, the Poll-Response service and the Change of State/ Cyclic service. The DeviceNet commands and services supported by the FDNA-01 DeviceNet Adapter module are discussed in chapter *Communication*.

The adapter module is mounted into an option slot on the motor control board of the drive. See the drive documentation for module placement options.

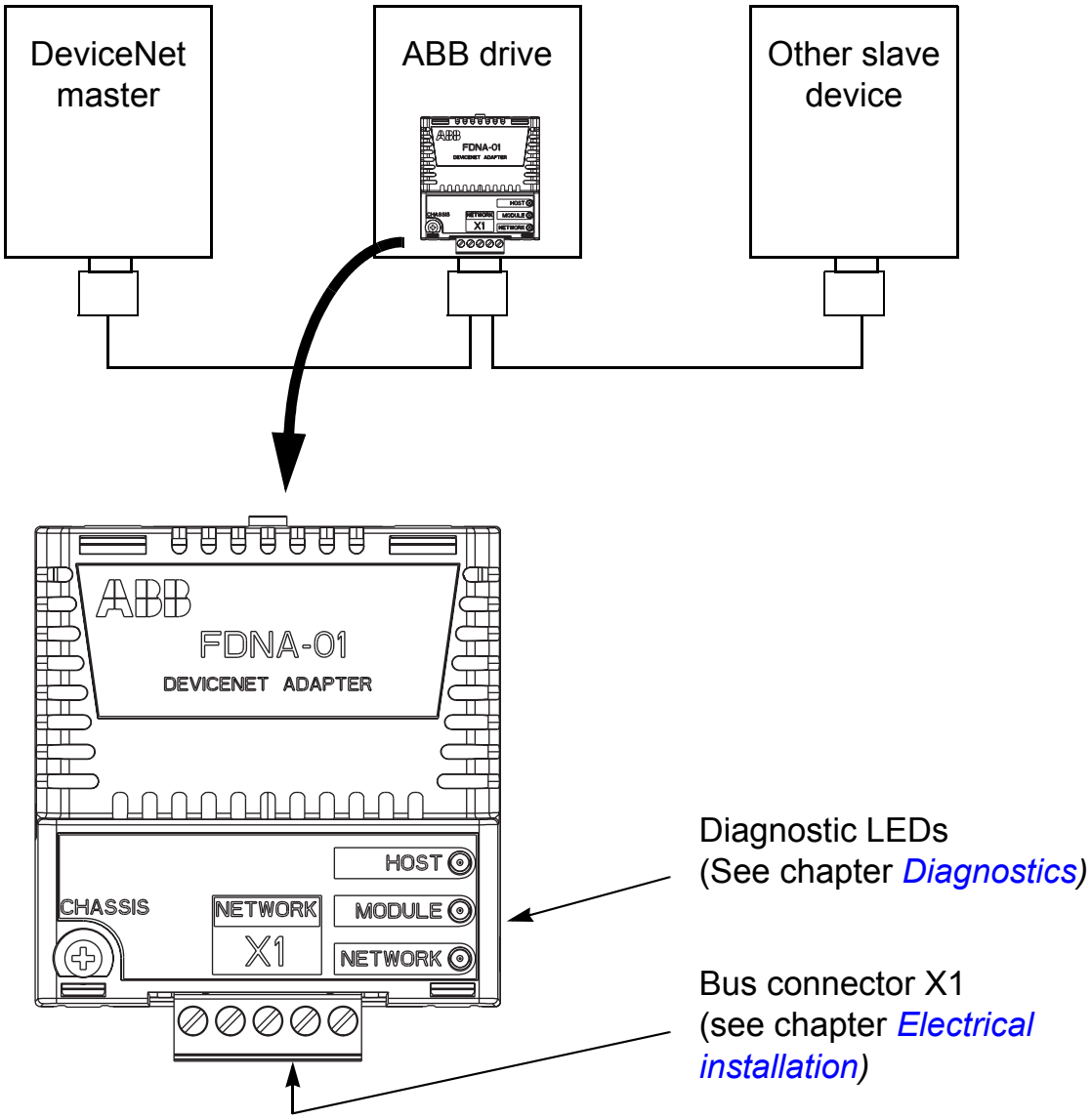


Figure 2. The construction of the DeviceNet link and the FDNA-01 Adapter module.

Compatibility

The FDNA-01 is compatible with all master stations that support the DeviceNet protocol.

Delivery check

The option package for the FDNA-01 DeviceNet Adapter module contains:

- DeviceNet Adapter module, type FDNA-01
- this manual.

FDNA-01 Quick Start Guide

Overview

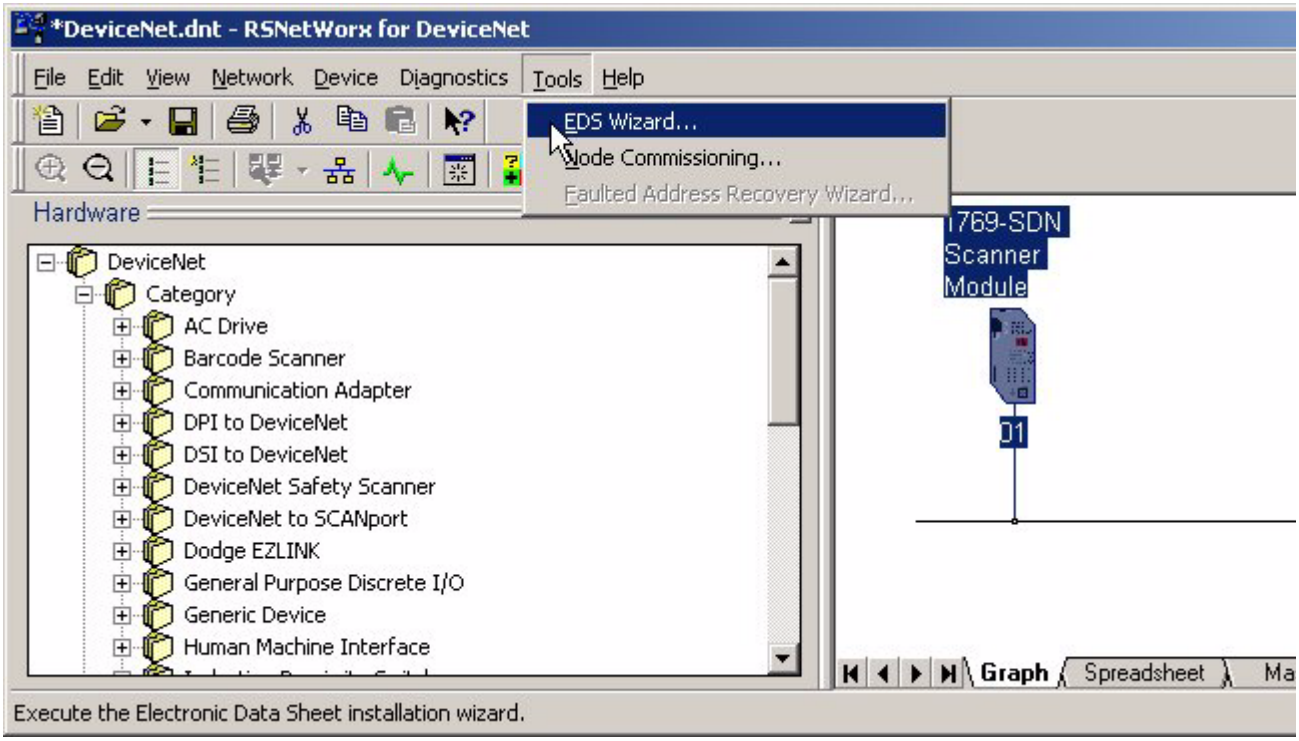
This document presents the steps to take during the start-up of the FDNA-01 DeviceNet Adapter Module.

PLC Configuration

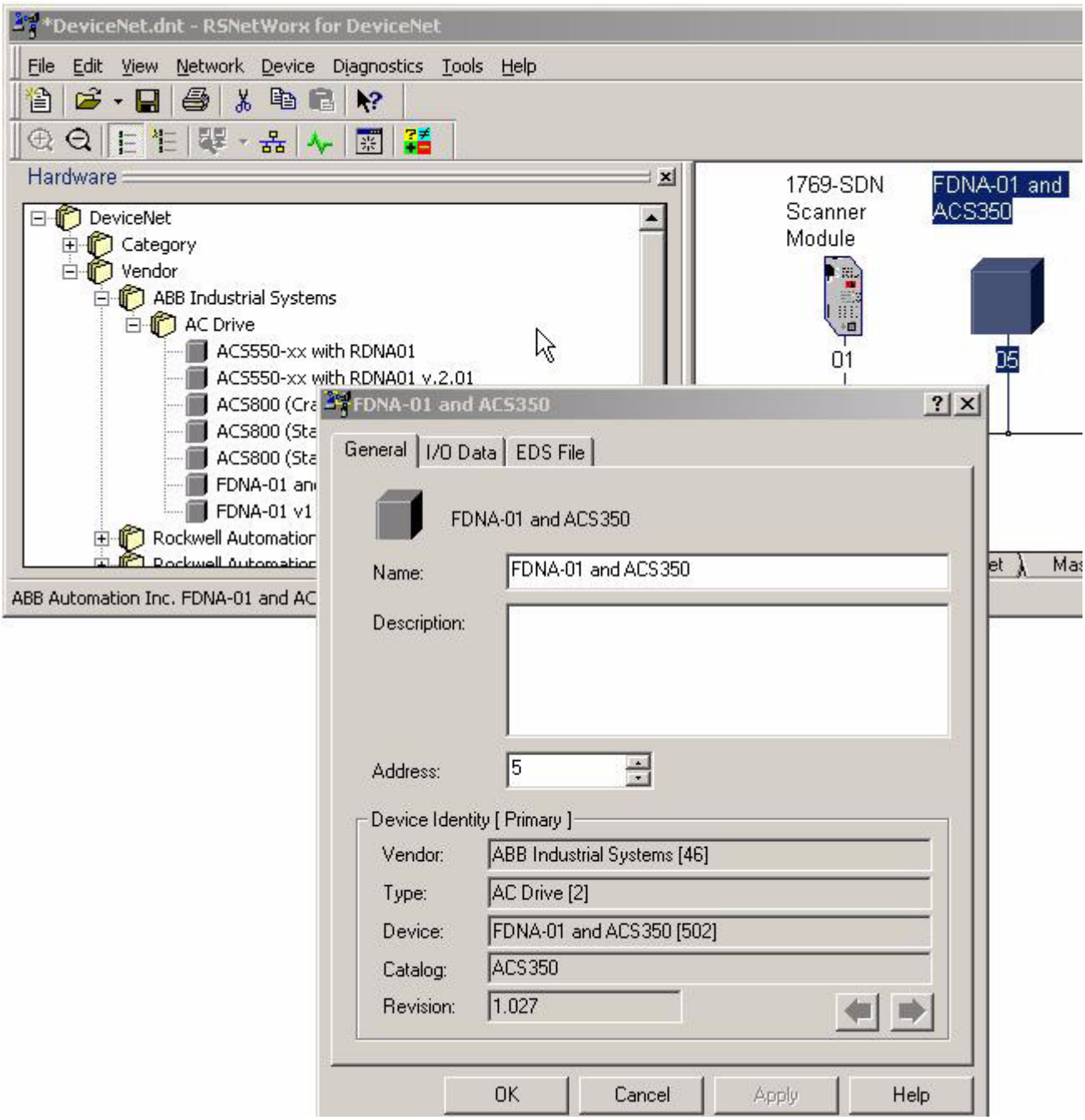
This is an example on how to set up an Allen-Bradley CompactLogix PLC with a 1769-SDN DeviceNet Scanner to use an ACS350 or ACSM1 equipped with a FDNA-01 fieldbus adapter, using RSNetWorx and RSLogix 5000 to configure and control the network. Slight vendor specific differences may exist when using other programs or master devices.

- Select and import the EDS file for drive, for example ACS350_FDNA01_v1.27_eu.EDS. For more help on choosing the correct file, refer to *ABB EDS Selection Guide* document delivered with the EDS files.

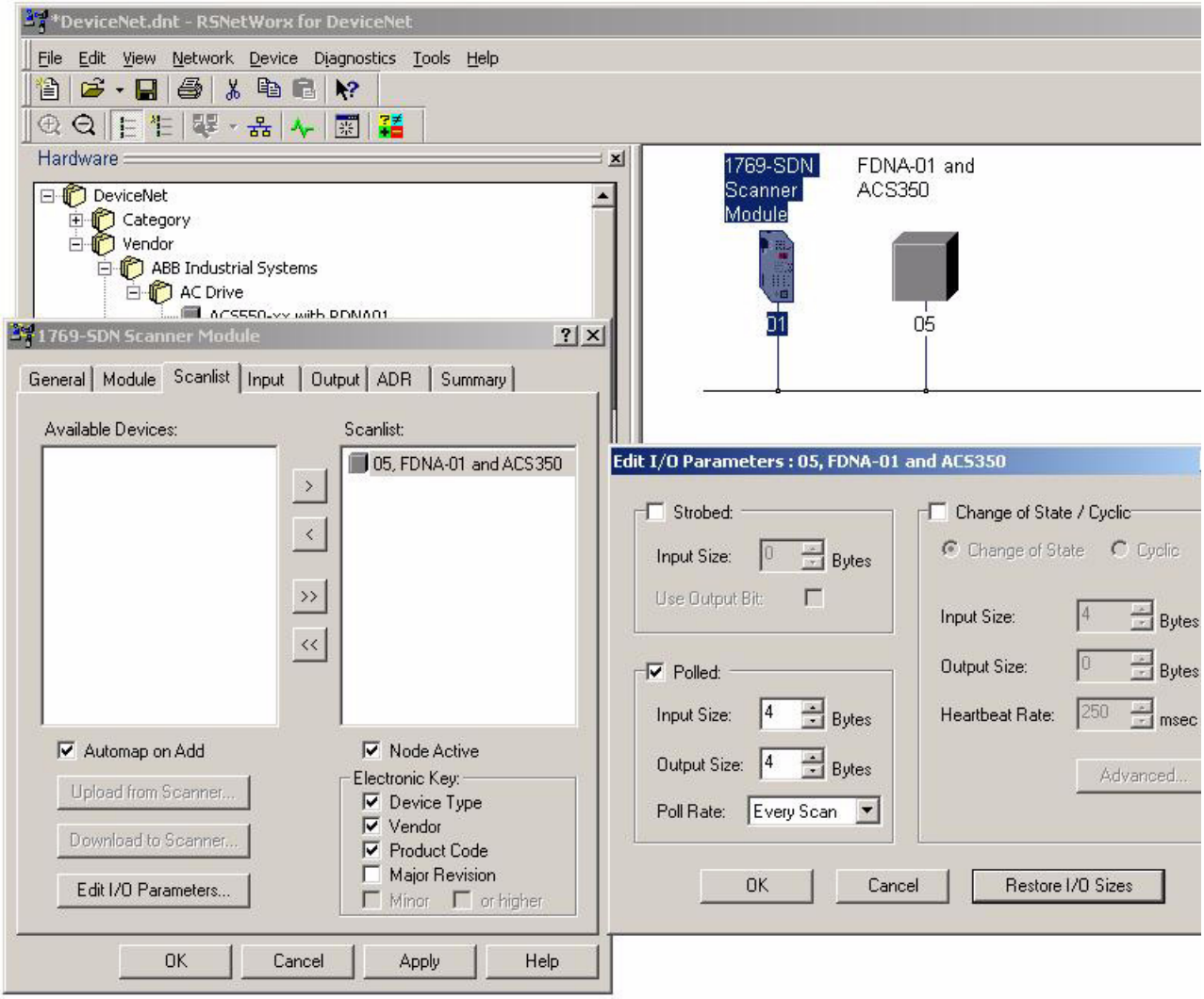
Note: Only one EDS file with the same Product ID can be installed in the PLC at a time.



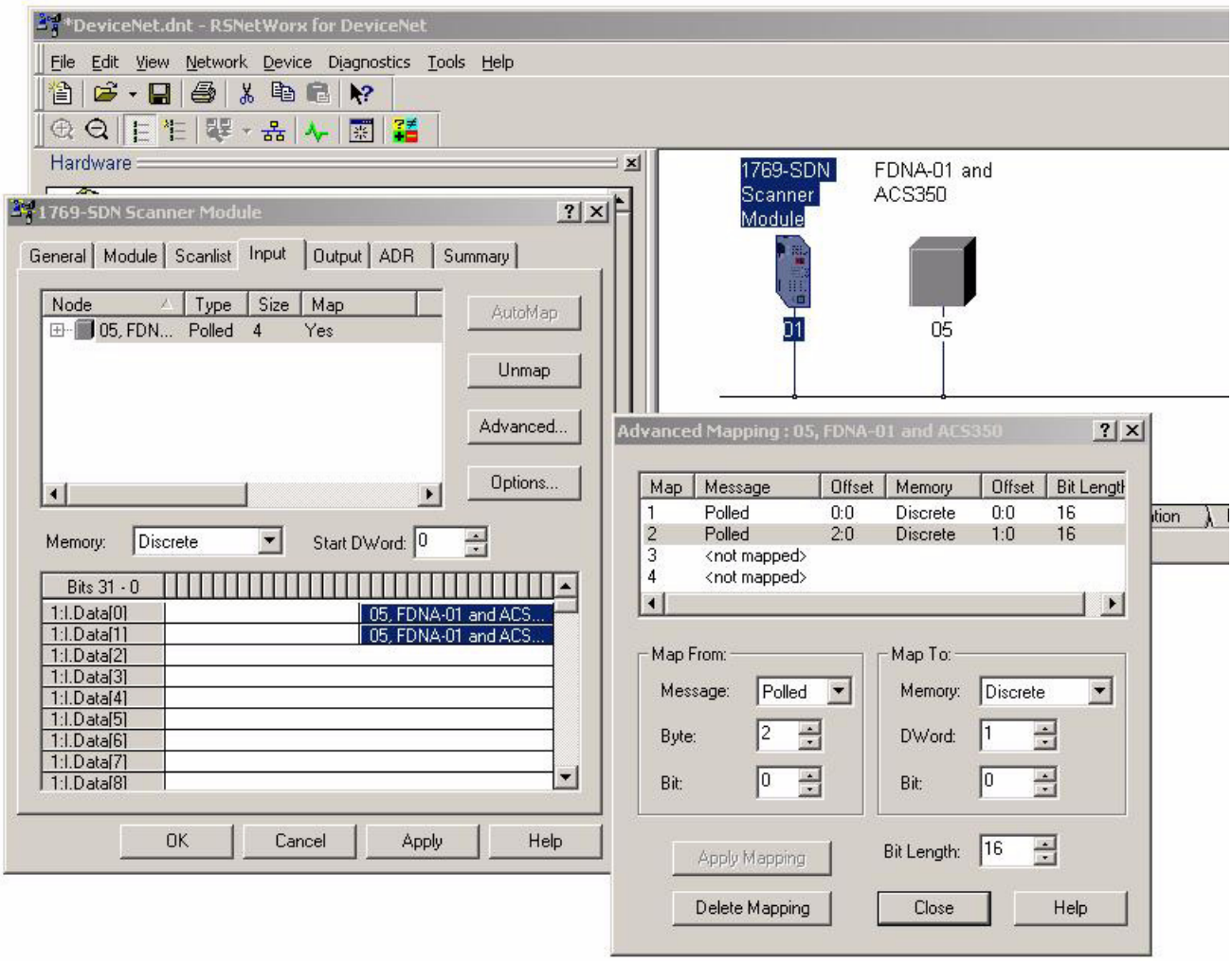
- Add drive to network in RSNetWorx for DeviceNet.
- Configure device MAC address.


*DeviceNet.dnt - RSNetWorx for DeviceNet
File Edit View Network Device Diagnostics Tools Help
Hardware
DeviceNet
Category
Vendor
ABB Industrial Systems
AC Drive
ACS550-xx with RDNA01
ACS550-xx with RDNA01 v.2.01
ACS800 (Cra
ACS800 (Sta
ACS800 (Sta
FDNA-01 an
FDNA-01 v1
Rockwell Automation
ABB Automation Inc. FDNA-01 and AC
1769-SDN
Scanner
Module
FDNA-01 and
ACS350
01
05
FDNA-01 and ACS350
General
I/O Data
EDS File
FDNA-01 and ACS350
Name:
FDNA-01 and ACS350
Description:
Address:
5
Device Identity [Primary]
Vendor:
ABB Industrial Systems [46]
Type:
AC Drive [2]
Device:
FDNA-01 and ACS350 [502]
Catalog:
ACS350
Revision:
1.027
OK
Cancel
Apply
Help

- Configure the DeviceNet Scanner. Add the drive to Scanlist and edit I/O parameters. Select Polled or Change of State/Cyclic. Then enter the input and output sizes of the I/O assemblies that will be used (e.g. for Basic Speed Control Assemblies 20 and 70, each size is set to 4 bytes.).



- For convenience, you can also edit the Input and Output memory mappings. By default, the two 16-bit input words are mapped into a single 32-bit double word. It is more convenient, however, to map them into separate double words. Output words can be mapped similarly.



- Download the scanner settings to the device in online mode.
- Add your DeviceNet scanner to an RSLogix 5000 project. You should get new Controller Tags Local:<slot>:I and Local:<slot>:O. You can use them to access the data as mapped above:

  Local:<slot>:O.Data[0] is the Control Word
  Local:<slot>:O.Data[1] is the Reference
  Local:<slot>:I.Data[0] is the Status Word
  Local:<slot>:I.Data[1] is the Actual Value

Note: You may need to change the value of Local:<slot>:O.CommandRegister.Run or

Local:<slot>:I.CommandRegister.Run to 1.

Mechanical and electrical installation

- Insert the FDNA-01 into its specified slot in the drive
- Fasten the screw
- Plug the fieldbus connector into the module

Note: It is recommended to set module communication settings (e.g. Baud rate) before connecting it to an active DeviceNet network (see below).

Drive configuration

Note: Configuring the drive for communication with the module is dependent on the drive type. Refer to the *Firmware Manual* of the drive for detailed information on configuring the drive to use the communication module.

- Power up the drive.
- Configure drive to enable module. With an ACS350 drive, set parameter 98.02 COMM PROT SEL to EXT FBA. With ACSM1, set parameter 50.01 FBA ENABLE to Enable and ensure that 50.04 FBA REF1 MODESEL is Speed and 50.05 FBA REF2 MODESEL is Torque.
- Verify that FBA TYPE is DEVICENET. On the ACS350 and ACSM1 drives, this is parameter 51.01.
- Configure drive to accept Start/Stop, Direction, Reference, Run Enable and Fault Reset from the module. Examples of appropriate values are shown in the following tables.
- Configure the module for desired network characteristics with the fieldbus configuration groups. Examples of suggested values are shown in the following tables.
- Initiate a "Fieldbus adapter parameter refresh" by setting parameter 51.27 FBA PAR REFRESH.

Note: The new settings take effect only when the module is powered up the next time or when a 'Fieldbus Adapter parameter refresh' is given (see the drive documentation).

Example Configuration: ODVA Basic Speed Control on ACS350

Drive parameter	Example setting for ACS350
10.01 EXT1 COMMANDS	COMM
11.03 REF1 SELECT	COMM
16.01 RUN ENABLE	NOT SEL[1]
16.04 FAULT RESET SEL	COMM
98.02 COMM PROT SEL	EXT FBA
51.01 FBA TYPE	DEVICENET
51.02 MAC ID	2
51.03 BAUD RATE	0 (125 kbit/s)
51.05 ODVA STOP FUNC	0 (Ramp Stop)
51.06 OUTPUT INSTANCE	20 (ODVA Basic Speed Control)
51.07 OUTPUT NUM PARS	10 [2]
51.08 INPUT INSTANCE	70 (ODVA Basic Speed Control)
51.09 INPUT NUM PARS	10 [2]
51.10 ODVA SPEED SCALE	128 (1 RPM)
51.11 ODVA TORQUE SCALE	128 (1 Nm)

[1] The ODVA AC/DC Drive Profile does not provide a means to supply a RUN ENABLE signal via DeviceNet. The RUN ENABLE for the drive must either be set to either NOT SEL or another source (e.g. a digital input).

[2] OUTPUT NUM PARS and INPUT NUM PARS should always be set to 10, except as provided for in the Appendix.

Scanner: Input and Output sizes are 4 bytes each.

Example Configuration: ABB Drives Profile w/ Speed and Torque plus Drive Parameters on ACS350. Output Drive Parameters will control Analog Output 1 and Relay Output 1. Input Drive Parameters will read Analog Input 1 (01.20), Current (01.04) and Power (01.06).

Drive parameter	**Example setting for ACS350**
10.01 EXT1 COMMANDS	COMM
11.03 REF1 SELECT	COMM
11.05 REF2 SELECT	COMM
14.01 RELAY OUTPUT 1	COMM
15.01 AO1 CONTENT SEL	COMM VALUE 1
16.01 RUN ENABLE	COMM[1]
16.04 FAULT RESET SEL	COMM
98.02 COMM PROT SEL	COMM
51.01 FBA TYPE	DEVICENET
51.02 MAC ID	53
51.03 BAUD RATE	2 (500kbit/s)
51.05 ODVA STOP FUNC	0 (= Ramp Stop) [2]
51.06 OUTPUT INSTANCE	902 (ABB Drives Profile w/ Speed and Torque plus Drive Parameters)
51.07 OUTPUT NUM PARS	10 [3]
51.08 INPUT INSTANCE	952 (ABB Drives Profile w/ Speed and Torque plus Drive Parameters)
51.09 INPUT NUM PARS	10 [3]
51.10 ODVA SPEED SCALE	128 (1 RPM) [2]
51.11 ODVA TORQUE SCALE	128 (1 Nm) [2]
54.01 FBA DATA IN 1	120 (01.20 Analog Input 1)
54.02 FBA DATA IN 2	104 (01.04 Current)
54.03 FBA DATA IN 3	106 (01.06. Power)
54.04 - 54.10 FBA DATA IN 4-10	0 (Unused)

55.01 FBA DATA OUT 1	135 (01.35 COMM VALUE 1)
55.02 FBA DATA OUT 2	134 (01.34 COMM RO WORD)
55.03 - 55.10 FBA DATA OUT 3-10	0 (Unused)

[1] The ABB Drives Profile does provide a means to supply a RUN ENABLE signal via DeviceNet. The RUN ENABLE for the drive may be set to COMM or another source (e.g. a digital input).

[2] These parameters are ignored when using ABB Drives profile.

[3] OUTPUT NUM PARS and INPUT NUM PARS should always be set to 10, except as provided for in the Appendix.

Scanner: Input and Output sizes are 26 bytes each.

Example Configuration: ODVA Extended Speed and Torque Control on ACSM1

Drive parameter	**Example setting for ACSM1**
10.01 EXT1 START FUNC	FBA
24.01 SPEED REF1 SEL	FBA REF1
32.01 TORQ REF1 SEL	FBA REF2
34.03 EXT1 CTRL MODE1	SPEED
34.04 EXT1 CTRL MODE2	TORQUE
50.01 FBA ENABLE	ENABLE
50.04 FBA REF1 MODESEL	SPEED
50.05 FBA REF2 MODESEL	TORQUE
51.01 FBA TYPE	DEVICENET
51.02 MAC ID	10
51.03 BAUD RATE	0 (125 kbit/s)
51.05 ODVA STOP FUNC	0 (=Ramp Stop)
51.06 OUTPUT INSTANCE	23 (ODVA Extended Speed and Torque Control)
51.07 OUTPUT NUM PARS	10[1]

51.08 INPUT INSTANCE	73 (ODVA Extended Speed and Torque Control)
51.09 INPUT NUM PARS	10[1]
51.10 ODVA SPEED SCALE	128 (1 RPM)
51.11 ODVA TORQUE SCALE	128 (1 Nm)

[1] OUTPUT NUM PARS and INPUT NUM PARS should always be set to 10, except as provided for in the Appendix

Scanner: Input and Output sizes are 6 bytes each

Example configuration: ABB Drives profile with Speed control with ACSM1

Drive parameter	**Example setting for ACSM1**
10.01 EXT1 START FUNC	FBA
24.01 SPEED REF1	FBA REF1
34.03 EXT1 CTRL MODE1	SPEED
50.01 FBA ENABLE	ENABLE
50.04 FBA REF1 MODESEL	SPEED
50.05 FBA REF2 MODESEL	TORQUE
51.01 FBA TYPE	DEVICENET
51.02 MAC ID	10
51.03 BAUD RATE	1 (250 kbit/s)
51.05 ODVA STOP FUNC	0 (= Ramp Stop)
51.06 OUTPUT INSTANCE	801 (ABB Drives with Set speed)
51.07 OUTPUT NUM PARS	10[2]
51.08 INPUT INSTANCE	851 (ABB Drives with Set speed)
51.09 INPUT NUM PARS	10[2]
51.10 ODVA SPEED SCALE	128 (1 RPM)
51.11 ODVA TORQUE SCALE	128 (1 Nm)

[1] These parameters are ignored when using ABB Drives profile.

[2] OUTPUT NUM PARS and INPUT NUM PARS should always be set to 10, except as provided for in the Appendix.

Mechanical installation

WARNING! Follow the safety instructions given in this manual and the drive documentation.

Mounting

The FDNA-01 is to be inserted into its specific position in the drive. The module is held in place with plastic pins and one screw. The screw also provides the earthing of the fieldbus cable shield connected to the module.

On installation of the module, the signal and power connection to the drive is made through a 20-pin connector. (All drives do not use all the available signals so the connector on the drive may have fewer pins.)

Mounting procedure:

- Insert the module carefully into its position on the drive.
- Fasten the screw.

Note: Correct installation of the screw is essential for fulfilling the EMC requirements and for proper operation of the module.

Electrical installation

Overview

This chapter contains:

- general cabling instructions
- instructions for connecting the module to the DeviceNet bus.

WARNING! Before installation, switch off the drive power supply. Wait 5 minutes to ensure that the capacitor bank of the drive is discharged. Switch off all dangerous voltages connected from external control circuits to the inputs and outputs of the drive.

General cabling instructions

Arrange the bus cables as far away from the motor cables as possible. Avoid parallel runs. Use bushings at cable entries.

DeviceNet connection

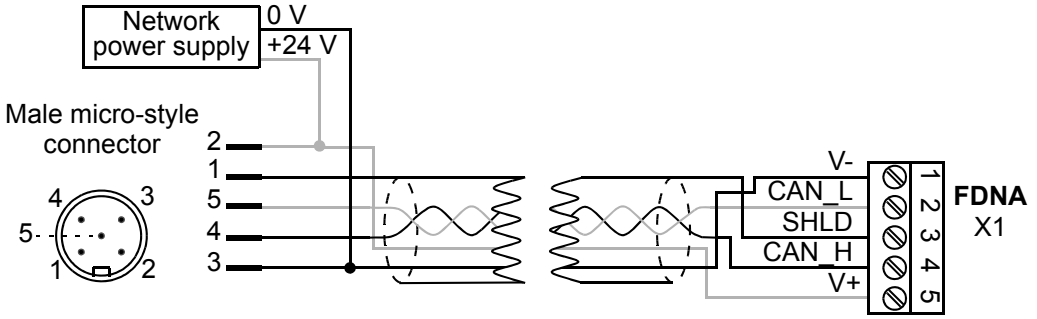
The bus cable is connected to terminal block X1 on the FDNA-01.

Terminal block description.

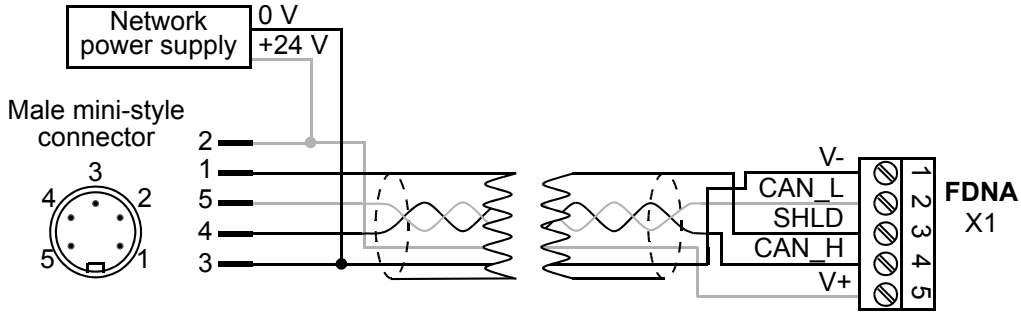
X1		Description
1	V-	Network power supply ground (0V DC)
2	CAN_L	CAN_L bus line
3	SHLD	Network cable shield
4	CAN_H	CAN_H bus line
5	V+	Network power supply source (24V DC)

Connection examples

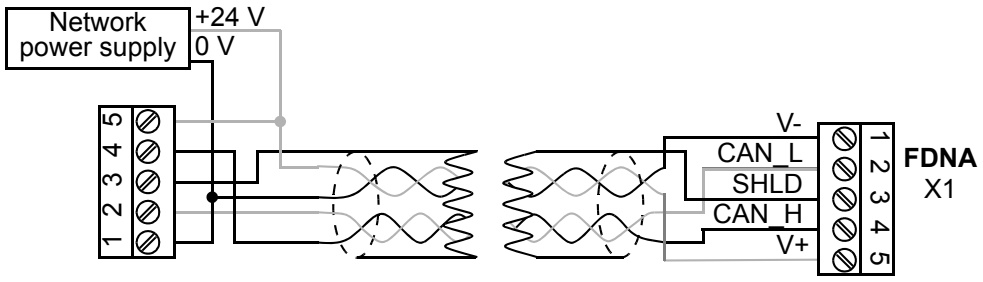
5-pin micro-style connector



5-pin mini-style connector

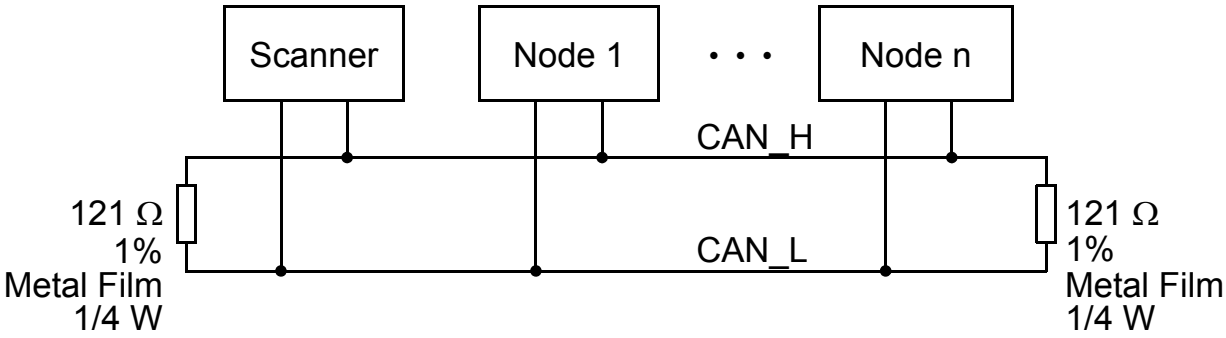


Standard open-style screw connector



DeviceNet bus termination

The FDNA-01 does not provide bus termination.The DeviceNet bus line must be terminated with 121 ohm resistors connected between the CAN_L and CAN_H wires at each end as shown below.



Drive configuration

Overview

This chapter gives information on configuring the FDNA-01 DeviceNet Adapter module.

DeviceNet connection configuration

After the FDNA-01 DeviceNet Adapter module has been mechanically and electrically installed according to the instructions in chapters *Mechanical installation* and *Electrical installation*, the drive must be prepared for communication with the module.

The detailed procedure of activating the module for DeviceNet communication with the drive is dependent on the drive type. Normally, a parameter must be adjusted to activate the communication (see the drive documentation).

As communication between the drive and the FDNA-01 is established, several configuration parameters are copied to the drive. These parameters (Tables 3, 8 and 9) must be checked first and adjusted where necessary. The alternative selections for these parameters are discussed in more detail below the tables.

Note: The new settings take effect only when the module is powered up the next time or when a ‘Fieldbus Adapter parameter refresh’ is given (see the drive documentation).

Note: If communication between the FDNA-01 and DeviceNet master is established, changes to the configuration parameters can be done also through *Fieldbus Configuration Object 91h*.

FDNA-01 Configuration Parameters - Group 1

*Table 3. FDNA-01 Configuration Parameters - Group 1 **

Par. no.	Parameter name	Alternative settings	Default setting
1	FBA TYPE	(Read-only)	DEVICENET
2	MAC ID	0 to 63	63
3	BAUD RATE	**(0)** 125 kbit/s; **(1)** 250 kbit/s; **(2)** 500 kbit/s	(0) 125 kbit/s
4	DRIVE PROFILE	(0) DCU Profile	(0) DCU Profile
5	ODVA STOP FUNC	**(0)** Ramp Stop; **(1)** Coast Stop	(0) Ramp Stop
6	OUTPUT INSTANCE	See Table 4.	20
7	OUTPUT NUM PARS	1 to 10 [1,2]	10
8	INPUT INSTANCE	See Table 4.	70
9	INPUT NUM PARS	1 to 10 [1,3]	10
10	ODVA SPEED SCALE	See Table 6.	128
11	ODVA TORQUE SCALE	See Table 7.	128

[1]See Appendix - Varying Number of Drive Parameters

[2]This parameter is only used when the Output Assembly Instance is 120, 121, 122, 123, 901, 902, 911, 912, 921, 922. It should always be set to the default, 10, except as described in the Appendix.

[3]This parameter is only used when the Input Assembly Instance is 170, 171, 172, 173, 951, 952, 961, 962, 971, 972. It should always be set to the default, 10, except as described in the Appendix.

*Actual parameter group number depends on the drive type. E.g. Group#1 equals to parameter Group 51 in ACS350 and ACSM1.

1 FBA TYPE

This parameter shows the fieldbus adapter type as detected by the drive. The value cannot be adjusted by the user.

If this parameter is undefined, the communication between the drive and the module has not been established.

2 MAC ID

Each device on the DeviceNet network must have a unique MAC ID number. This parameter is used to define the MAC ID number for the drive it is connected to.

3 BAUD RATE

Sets the baud rate for the DeviceNet interface. This is user selectable, but must be the same on every node on the DeviceNet network.

4 DRIVE PROFILE

The “drive profile” defines the communication used between the module and the drive (not fieldbus and module). If a drive supports more than one drive profile, this parameter is used to select the preferred profile. Presently to use the ODVA and ABB Drives profiles the drive must support the DCU profile. Transparent16 and Transparent32 profiles may be used with any drive profile.

5 ODVA STOP FUNC

This parameter only applies when using the ODVA AC/DC Drive Profile. It determines how the motor will be stopped when a stop command is received via DeviceNet

0 = Ramp stop: the motor decelerates along the active deceleration ramp.

1 = Coast stop: the motor comes to a stop by coasting.

6 OUTPUT INSTANCE

8 INPUT INSTANCE

These parameters configure the output and input assembly instances used by the DeviceNet Adapter Module. The following tables list supported assemblies and allowed combinations. For

descriptions of assembly instances, see Communication - Assembly Objects.

Table 4. Assembly Instances

Name	Output Instance	Input Instance	Default Input Size (bytes)	Profile
Basic Speed Control	20	70	4	ODVA AC/DC Drive
Enhanced Speed Control	21	71	4	ODVA AC/DC Drive
Basic Speed and Torque Control	22	72	6	ODVA AC/DC Drive
Enhanced Speed and Torque Control	23	73	6	ODVA AC/DC Drive
Basic Speed Control plus Drive Parameters	120	170	24	ODVA AC/DC Drive
Enhanced Speed Control plus Drive Parameters	121	171	24	ODVA AC/DC Drive
Basic Speed and Torque Control plus Drive Parameters	122	172	26	ODVA AC/DC Drive
Enhanced Speed and Torque Control plus Drive Parameters	123	173	26	ODVA AC/DC Drive
ABB Drives Profile w/ Set Speed	801	851	4	ABB Drives Profile
ABB Drives Profile w/ Set Speed and Set Torque	802	852	6	ABB Drives Profile
ABB Drives Profile w/ Set Speed plus Drive Parameters	901	951	24	ABB Drives Profile
ABB Drives Profile w/ Set Speed and Set Torque plus Drive Parameters	902	952	26	ABB Drives Profile
Transparent16 w/One	811	861	4	Transparent16 Profile
Transparent16 w/Two	812	862	6	Transparent16 Profile
Transparent16 w/One plus Drive Parameters	911	961	24	Transparent16 Profile
Transparent16 w/Two plus Drive Parameters	912	962	26	Transparent16 Profile
Transparent32 w/One	821	871	8	Transparent32 Profile

Name	Output Instance	Input Instance	Default Input Size (bytes)	Profile
Transparent32 w/Two	822	872	12	Transparent32 Profile
Transparent32 w/One plus Drive Parameters	921	971	28	Transparent32 Profile
Transparent32 w/Two plus Drive Parameters	922	972	32	Transparent32 Profile

Note: With ACSM1, when using ODVA AC/DC Drive or ABB Drives profile, make sure that the drive parameter 50.4 FBA REF MODESEL is set to SPEED and 50.5 FBA REF2 MODESEL is set to TORQUE.

Table 5. Allowed Output/Input Assembly Instance Combinations

Output/Input	ODVA (70-73; 170-173)	ABB DRIVES (851-852; 951-952)	TRANSPARENT16 (861-862; 961-962)	TRANSPARENT32 (871-872; 971-972)
ODVA (20-23; 120-123)	X			
ABB DRIVES (801-802; 901-902)		X		
TRANSPARENT16 (811-812; 911-912)			X	
TRANSPARENT32 (821-822; 921-922)				X

7 OUTPUT NUM PARS

9 INPUT NUM PARS

Some assembly instances support transferring drive parameter values between the I/O scanner and drive. These parameters specify how many drive parameter values should be included in the respective assembly instance. Changing the numbers of drive parameters to values other than the defaults also changes the lengths of the associated assembly instances. This requires manual changes to either the EDS file or I/O scanner configuration. Please consult the Appendix - Varying Number of Drive Parameters before changing these parameters.

10 ODVA SPEED SCALE

This parameter only applies when using the ODVA AC/DC Drive Profile. Units of reference and actual speeds for ODVA AC/DC Drive profiles are given by the formula below. This parameter does not affect ABB Drives profiles. Note that while a wide range of resolutions may be configured, actual performance will be limited to the performance capabilities of the drive.

Speed Unit = RPM X $2^{(-1 \text{ X ODVA Speed Scale Value})}$

Table 6. ODVA Speed Scaling

ODVA Speed Scale Value[1]	**Drive Parameter Speed Scale Value[2]**	**Unit**
-5	123	32 RPM
-4	124	16 RPM
-3	125	8 RPM
-2	126	4 RPM
-1	127	2 RPM
0 (default)	128	1 RPM
1	129	0.5 RPM
2	130	0.25 RPM
3	131	0.125 RPM
4	132	0.0625 RPM
5	133	0.03125 RPM

[1] Use “ODVA Speed Scale Value” when reading/writing ODVA Speed Scale via the AC/DC Drive Object (2Ah). When written via AC/DC Drive Object, the new value takes effect immediately.

[2] Use “Drive Parameter Speed Scale Value” when reading/writing ODVA Speed Scale via Drive Panel, Drive Parameter Object (90h) and Drive Configuration Object (91h). When written via these methods, the new value takes effect after the drive is repowered or a “Fieldbus Adapter Parameter refresh” is given.

11 ODVA TORQUE SCALE

This parameter only applies when using the ODVA AC/DC Drive Profile. Units of reference and actual torques for ODVA AC/DC Drive profiles are given by the formula below. This parameter does not affect ABB Drives profiles. Note that while a wide range of resolutions may be configured, actual performance will be limited to the performance capabilities of the drive. (Nm = Newton x Meter)

Torque Unit = Nm x $2^{(-1 \text{ X ODVA Torque Scale})}$

Table 7. ODVA Torque Scaling

ODVA Torque Scale Value[1]	**Drive Parameter Torque Scale Value[2]**	**Unit**
-5	123	32 Nm
-4	124	16 Nm
-3	125	8 Nm
-2	126	4 Nm
-1	127	2 Nm
0 (default)	128	1 Nm
1	129	0.5 Nm
2	130	0.25 Nm
3	131	0.125 Nm
4	132	0.0625 Nm
5	133	0.03125 Nm

[1]Use “ODVA Torque Scale Value” when reading/writing ODVA Torque Scale via the AC/DC Drive Object (2Ah). When written via AC/DC Drive Object, the new value takes effect immediately.

[2] Use “Drive Parameter Torque Scale Value” when reading/writing ODVA Torque Scale via Drive Panel, Drive Parameter Object (90h) and Drive Configuration Object (91h). When written via these methods, the new value takes effect after the drive is repowered or a “Fieldbus Adapter Parameter refresh” is given.

FDNA-01 Configuration Parameters - Group 2 (output data)

Table 8. FDNA-01 Configuration Parameters - Group 2

Par. no.	Parameter name	Alternative settings	Default setting
1	DATA OUT 1 (master to drive)	0 to 9999 Format: **xxyy**, where **xx** = parameter group and **yy** = parameter index.	0
2	DATA OUT 2	See DATA OUT 1 above.	0
3	DATA OUT 3	See DATA OUT 1 above.	0
4	DATA OUT 4	See DATA OUT 1 above.	0
5	DATA OUT 5	See DATA OUT 1 above.	0
6	DATA OUT 6	See DATA OUT 1 above.	0
7	DATA OUT 7	See DATA OUT 1 above.	0
8	DATA OUT 8	See DATA OUT 1 above.	0
9	DATA OUT 9	See DATA OUT 1 above.	0
10	DATA OUT 10	See DATA OUT 1 above.	0

1 DATA OUT 1

In output assembly instances that include drive parameters, this parameter specifies which parameter's value will be placed in location DATA OUT 1 Value received by the drive from the DeviceNet network. Content is specified by a decimal number as follows.

0	Unused
1 - 99	Virtual Address Area of Drive
101 - 9999	Parameter Area of Drive

Parameter numbers are formatted as xxyy, where xx is the parameter group number (1 to 99) and yy is the parameter index within that group (01 to 99). For example, parameter 99.02 would be entered as 9902.

*Actual parameter group number depends on the drive type. E.g. Group#2 equals to parameter Group 55 in ACS350 or group 53 in ACSM1.

2-10 DATA OUT 2 to DATA OUT 10

See DATA OUT 1 above.

FDNA-01 Configuration Parameters - Group 3 (Input data)

*Table 9. FDNA-01 Configuration Parameters - Group 3**

Par. no.	Parameter name	Alternative settings	Default setting
1	DATA IN 1 (drive to master)	0 to 9999 Format: **xxyy**, where **xx** = parameter group and **yy** = parameter index.	0
2	DATA IN 2	See DATA IN 1 above.	0
3	DATA IN 3	See DATA IN 1 above.	0
4	DATA IN 4	See DATA IN 1 above.	0
5	DATA IN 5	See DATA IN 1 above.	0
6	DATA IN 6	See DATA IN 1 above.	0
7	DATA IN 7	See DATA IN 1 above.	0
8	DATA IN 8	See DATA IN 1 above.	0
9	DATA IN 9	See DATA IN 1 above.	0
10	DATA IN 10	See DATA IN 1 above.	0

1 DATA IN 1

In input assembly instances that include drive parameters, this parameter specifies which parameter's value will be placed in location DATA IN 1 Value sent by the drive to the DeviceNet network. Content is specified by a decimal number as follows.
Unused

1 - 99 Virtual Address Area of Drive

101 - 9999 Parameter Area of Drive

Parameter numbers are formatted as xxyy, where xx is the parameter group number (1 to 99) and yy is the parameter index within that group (01 to 99). For example, parameter 99.02 would be entered as 9902.

*Actual parameter group number depends on the drive type. E.g. Group#3 equals to parameter Group 54 in ACS350 or group 52 in ACSM1.

2-10 DATA IN 2 to DATA IN 10

See DATA IN 1 above.

NOTE: The FDNA-01 configuration parameters are 16-bit parameters. If the mapped parameter is a 32-bit parameter, it automatically reserves two consecutive parameters. E.g., mapping of a 32-bit parameter to parameter no. 1 reserves also parameter no. 2.

Control locations

ABB drives can receive control information from multiple sources including digital inputs, analogue inputs, the drive control panel and a communication module (e.g. FDNA-01). ABB drives allow the user to separately determine the source for each type of control information (Start, Stop, Direction, Reference, Fault Reset, etc.). In order to give the fieldbus master station the most complete control over the drive, the communication module must be selected as source for this information. See the user documentation of the drive for information on the selection parameters.

Master configuration

Overview

This chapter gives information on configuring the DeviceNet master station for communication through the FDNA-01 DeviceNet Adapter module.

Configuring the system

After the FDNA-01 DeviceNet Adapter module has been mechanically and electrically installed according to the instructions in previous chapters, and has been initialized by the drive, the master station must be prepared for communication with the module.

Please refer to the Scanner documentation for information on configuring the system for communication with the FDNA-01.

EDS files

Electronic Data Sheet (EDS) files specify the properties of the device for the DeviceNet scanner. The device is identified by the DeviceNet scanner by means of the Product Code, Device Type, and Major Revision (See Identity Object 01h).

To enable the use of different ABB drive types on the same DeviceNet network, a unique Product Code has been given to each drive type and application combination.

EDS files are available from your ABB representative.

Note: Only one EDS file with the same DeviceNet Product Code can be installed in the PLC at a time.

Communication profiles

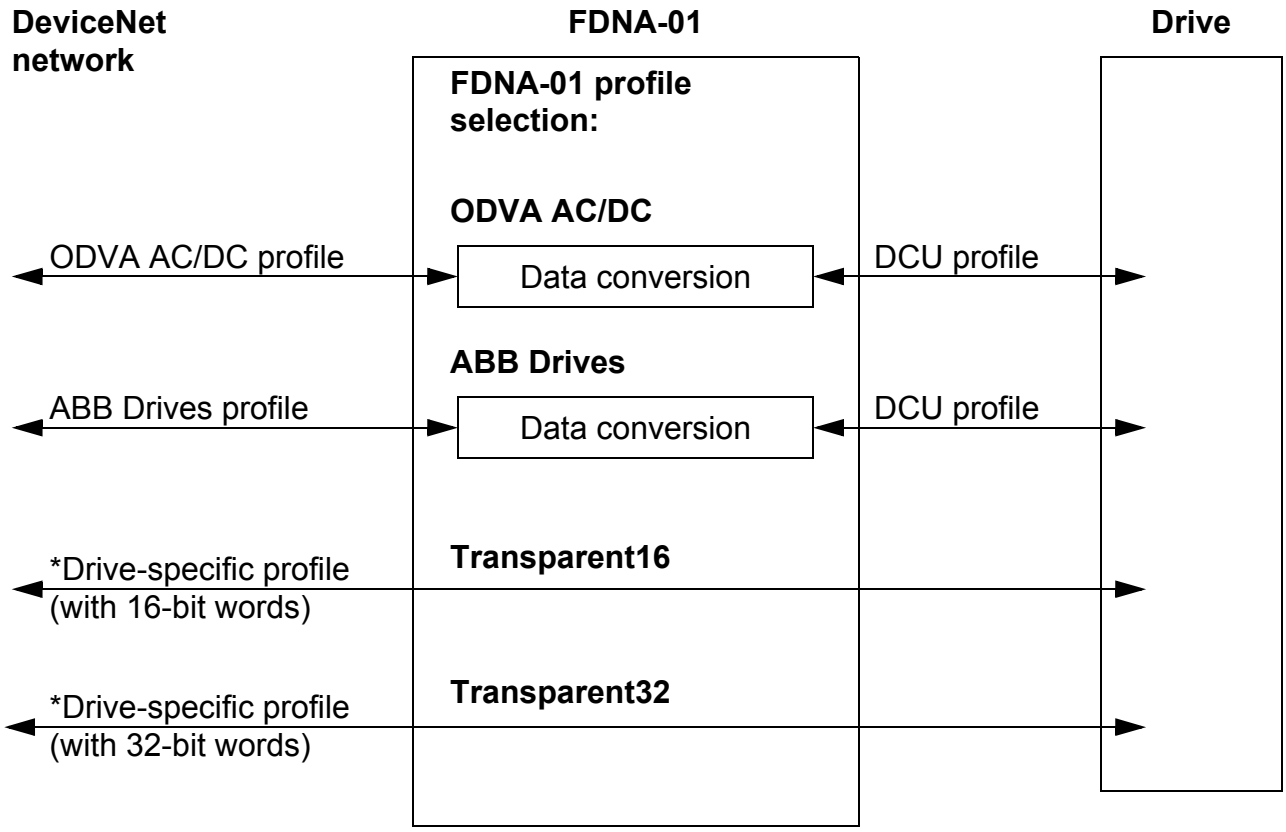
Overview

This chapter describes the communication profiles used in the communication between the DeviceNet network, the FDNA-01 module, and the drive.

Communication profiles

Communication profiles are ways of conveying control commands (Control word, Status word, references and actual values) between the master station and the drive.

With the FDNA-01 module, the DeviceNet network may employ either the ODVA AC/DC Drive profile or the ABB Drives profile. Both are converted to the DCU profile (detailed in drive documentation) by the FDNA-01 module. In addition, two Transparent modes for 16 and 32 bit words respectively are available. With the Transparent modes, no data conversion takes place.



*To be used if the drive does not support the DCU communication profile.

The following sections describe the Control word, the Status word, references and actual values for the ODVA AC/DC Drive and ABB Drives communication profiles. Refer to the drive manuals for details on the DCU communication profile.

The ODVA AC/DC Drive Profiles

This section briefly describes the ODVA AC/DC Drive Profiles. Additional information can be obtained from www.odva.org.

A DeviceNet node is modeled as a collection of abstract objects. Each object represents the interface to and behaviour of a component within the product. The ODVA AC/DC Drive Profiles define a collection of objects suitable for the control of AC and DC drives. Objects supported by the FDNA-01 DeviceNet Adapter are listed in Communications – Class Objects.

Objects are defined by:

- Service
- Class
- Instance
- Attribute
- Behavior

For example, to set the drive speed reference, the Set_Attribute_Single service can be requested for Attribute SpeedRef of the Class AC/DC Drive Object. The resulting behavior is that the reference speed of the drive is set to the requested value.

This is an example of *Explicit Messaging* where each attribute of a class is set individually. While this is allowed, it is inefficient. Instead *Implicit Messaging* using Input and Output Assembly Instances is recommended. *Implicit Messaging* allows the DeviceNet Master to set or get predefined groups of attributes in a single message exchange. Assembly Instances supported by the FDNA-01 are listed and defined in Communications – Assembly Objects.

ODVA Output Attributes

This section briefly describes the instances found in the ODVA AC/DC Drive Profiles output assemblies. Not all attributes listed here will be supported by all output assembly instances.

Run Forward & Run Reverse (Control Supervisor Object)

These attributes are used to assert run and stop commands to Control Supervisor Object state machine (see “State” below) according to the following table.

Table 10. Run/Stop event matrix

RunFwd	RunRev	Trigger event	Run type
0	0	Stop	N/A
0 → 1	0	Run	RunFwd
0	0 → 1	Run	RunRev
0 → 1	0 → 1	No Action	N/A
1	1	No Action	N/A
0 → 1	1	Run	RunRev
1	1 → 0	Run	RunFwd

Fault Reset (Control Supervisor Object)

This attribute resets a drive fault on a transition from zero to one if the condition that caused the fault has been cleared.

Net Ctrl (Control Supervisor Object)

This attribute requests that the drive Run/Stop command be supplied locally (Net Ctrl = 0) or by the network (Net Ctrl = 1).

Net Ref (AC/DC Drive Object)

This attribute requests that the drive speed and torque references be supplied locally (Net Ref = 0) or by the network (Net Ref = 1).

Speed Reference (AC/DC Drive Object)

This attribute is the speed reference for the drive. The units are scaled by the Speed Scale attribute of the AC/DC Drive Object. See Table 6. for details.

Scalar Mode

When the drive is operating in scalar mode, the FDNA-01 provides the drive with a frequency reference. The ODVA AC/DC Drive Profiles use rpm units for the speed reference. The drive frequency reference is calculated according to

Dfr Drive Frequency Reference in Hz

Osr ODVA Speed Reference

Us ODVA Speed Unit (from Table 6)

Mf Motor Nominal Frequency in Hz

Mss Motor Synchronous Speed in rpm (not Motor Nominal Speed).

$$\mathrm{Dfr} = \frac{\mathrm{Osr} \times \mathrm{Us} \times \mathrm{Mf}}{\mathrm{Mss}}$$

For a 4 pole 60 Hz motor (Mss = 1800 rpm) with a unit 1 rpm and an ODVA Speed Reference of 900.

$$\mathrm{Dfr} = \frac{\mathrm{Osr} \times \mathrm{Us} \times \mathrm{Mf}}{\mathrm{Mss}} = \frac{900 \times 1\,\mathrm{rpm} \times 60\,\mathrm{Hz}}{1800\,\mathrm{rpm}} = 30\,\mathrm{Hz}$$

Vector Mode

When the drive is operating in vector mode, the FDNA-01 provides the drive with a speed reference. The ODVA AC/DC Drive Profiles use rpm units for the speed reference. The drive speed reference is calculated according to

Dsr Drive Speed Reference in rpm

Osr ODVA Speed Reference

Us ODVA Speed Unit (from Table 6).

$$\mathrm{Dsr} = \mathrm{Osr} \times \mathrm{Us}$$

For an ODVA Speed Reference of 900 rpm with a unit of 0.5 rpm.

$$Dsr = Osr \times Us = 900 \times 0.5rpm = 450rpm$$

Torque Reference (AC/DC Drive Object)

This attribute is the torque reference for the drive. The units are scaled by the Torque Scale attribute of the AC/DC Drive Object. See Table 7. for details.

The FDNA-01 provides the drive with a torque reference in percent of motor nominal torque. The ODVA AC/DC Drive Profiles use Newton-meter (Nm) units for the torque reference. The drive torque reference is calculated according to

Dtr Drive Torque Reference in Percent of Motor Nominal Torque

Otr ODVA Torque Reference

Ut ODVA Torque Unit (from Table 7)

Mt Motor Nominal Torque in Nm.

$$Dtr = \frac{100 \times Otr \times Ut}{Mt}$$

For a 1000 Nm Motor Nominal Torque with a unit of 1 Nm and an ODVA Torque Reference of 500.

$$Dtr = \frac{100 \times Otr \times Ut}{Mt} = \frac{100 \times 500 \times 1\,Nm}{1000\,Nm} = 50$$

ODVA Input Attributes

This section briefly describes the instances found in the ODVA AC/DC Drive Profiles input assemblies. Not all attributes listed here will be supported by all input assembly instances.

Faulted (Control Supervisor Object)

This attribute indicates that the drive has experienced a fault. The fault code may be read from the FaultCode attribute of the Control Supervisor Object.

Warning (Control Supervisor Object)

This attribute indicates that the drive is experiencing a warning condition. The warning code may be read from the WarnCode attribute of the Control Supervisor Object.

Running Forward (Control Supervisor Object)

This attribute indicates that the drive is running in the forward direction.

Running Reverse (Control Supervisor Object)

This attribute indicates that the drive is running in the reverse direction.

Ready (Control Supervisor Object)

This attribute indicates that the Control Supervisor Object state machine (see “State” below) is in the Ready, Running or Stopping state.

Ctrl From Net (Control Supervisor Object)

This attribute indicates if the Run/Stop command is being supplied locally (Ctrl From Net = 0) or by the network (Ctrl From Net = 1).

Ref From Net (AC/DC Drive Object)

This attribute indicates if the Speed and Torque references are being supplied locally (Ref From Net = 0) or by the network (Ref From Net = 1).

At Reference (AC/DC Drive Object)

This attribute indicates the drive is operating at the specified speed or torque reference.

State (Control Supervisor Object)

This attribute indicates the current state of the Control Supervisor Object.

Table 11. Control Supervisor States.

State	Description	State	Description
0	Vendor Specific	4	Enabled
1	Startup	5	Stopping
2	Not Ready	6	Fault Stop
3	Ready	7	Faulted

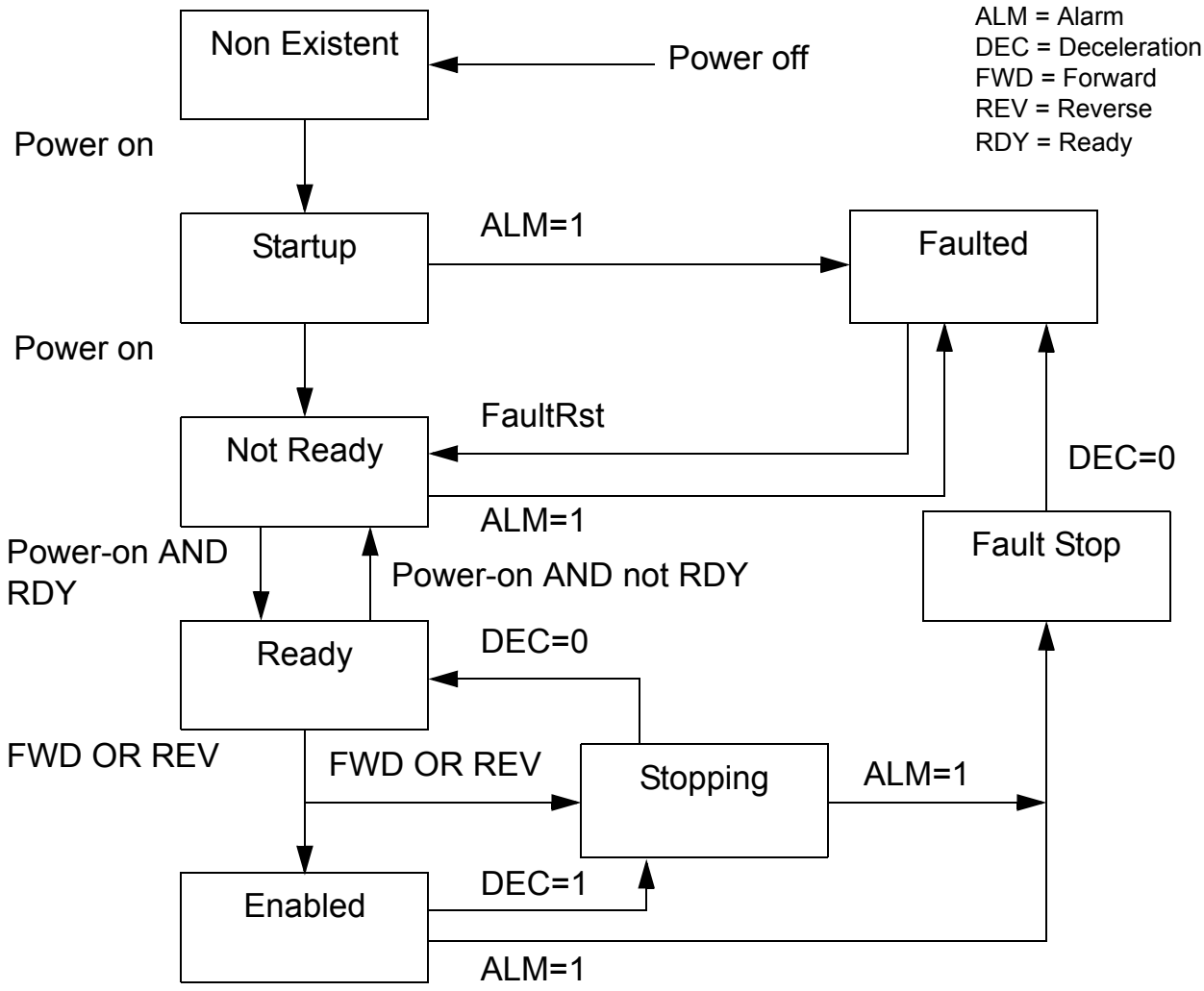


Figure 12. ODVA state transition diagram

Speed Actual (AC/DC Drive Object)

This attribute indicates the actual speed at which the drive is operating. The units are scaled by the SpeedScale attribute of the AC/DC Drive Object. See Table 6. for details.

Scalar Mode

When the drive is operating in scalar mode, the drive provides the FDNA-01 with a frequency actual. The ODVA AC/DC Drive Profiles use rpm units for the speed actual. The ODVA Speed Actual is calculated according to

Osa ODVA Speed Actual

Dfa Drive Frequency Actual in Hz

Us ODVA Speed Unit (from Table 6)

Mf Motor Nominal Frequency in Hz

Mss Motor Synchronous Speed in rpm (not Motor Nominal Speed).

$$\text{Osa} = \frac{\text{Dfa} \times \text{Mss}}{\text{Mf} \times \text{Us}}$$

For a 4 pole 60 Hz motor (Mss = 1800 rpm) with a unit of 1 rpm and a Drive Frequency Actual or 30 Hz.

$$\text{Osa} = \frac{\text{Dfa} \times \text{Mss}}{\text{Mf} \times \text{Us}} = \frac{30\text{Hz} \times 1800\text{rpm}}{60\text{Hz} \times 1\text{rpm}} = 900$$

Vector Mode

When the drive is operating in vector mode, the drive provides the FDNA-01 with a speed actual. The ODVA AC/DC Drive Profiles use rpm units for the speed actual. The ODVA Speed Actual is calculated according to

Dsa Drive speed Actual in rpm

Osa ODVA Speed Actual

Us ODVA Speed Unit (from Table 6)

$$\text{Osa} = \frac{\text{Dsa}}{\text{Us}}$$

For a Drive Speed Actual of 900 rpm with a unit of 0.5 rpm.

$$\text{Osa} = \frac{\text{Dsa}}{\text{Us}} = \frac{450\,\text{rpm}}{0.5\,\text{rpm}} = 900$$

Torque Actual (AC/DC Drive Object)

This attribute indicates the actual torque at which the drive is operating. The units are scaled by the Torque Scale attribute of the AC/DC Drive Object. See Table 7. for details.

The drive provides the FDNA-01 with a torque actual in percent of Motor Nominal Torque. The ODVA AC/DC Drive Profiles use Newton-meter (Nm) units for the torque actual. The ODVA Torque Actual is calculated according to

Dta Drive Torque Actual in Percent of Motor Nominal Torque

Ota ODVA Torque Actual

Ut ODVA Torque Unit (from Table 7)

Mt Motor Nominal Torque in Nm

$$\mathrm{Ota} = \frac{\mathrm{Dta} \times \mathrm{Mt}}{100 \times \mathrm{Ut}}$$

For a 1000 Nm Motor Nominal Torque with a unit of 1 Nm and a drive torque actual of 50%.

$$\mathrm{Ota} = \frac{\mathrm{Dta} \times \mathrm{Mt}}{100 \times \mathrm{Ut}} = \frac{50 \times 1000\,\mathrm{Nm}}{100 \times 1\,\mathrm{Nm}} = 500$$

The ABB Drives communication profile

The Control Word and the Status Word

The Control Word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions on the Control Word, and returns status information to the master in the Status Word.

The contents of the Control Word and the Status Word are detailed in Tables 13 and 14 respectively. The drive states are presented in the ABB Drives profile state machine (Figure 15).

References

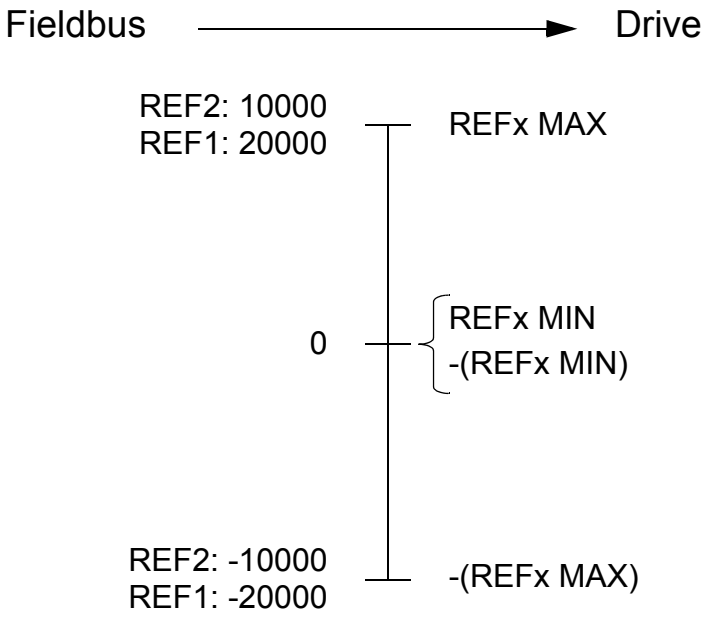
References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

ABB drives can receive control information from multiple sources including analogue and digital inputs, the drive control panel and a communication module (e.g. FDNA-01). In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information, e.g. Reference.

Scaling

References are scaled as shown below.

Note: The values of REF1 MAX and REF2 MAX are set by drive parameters. See the drive documentation for further information.



Actual values

Actual values are 16-bit words containing information on the operation of the drive. The functions to be monitored are selected by a drive parameter.

Scaling

Actual values are scaled as shown below.

Note: The values of REF1 MAX and REF2 MAX are set by drive parameters. See the drive documentation for further information.

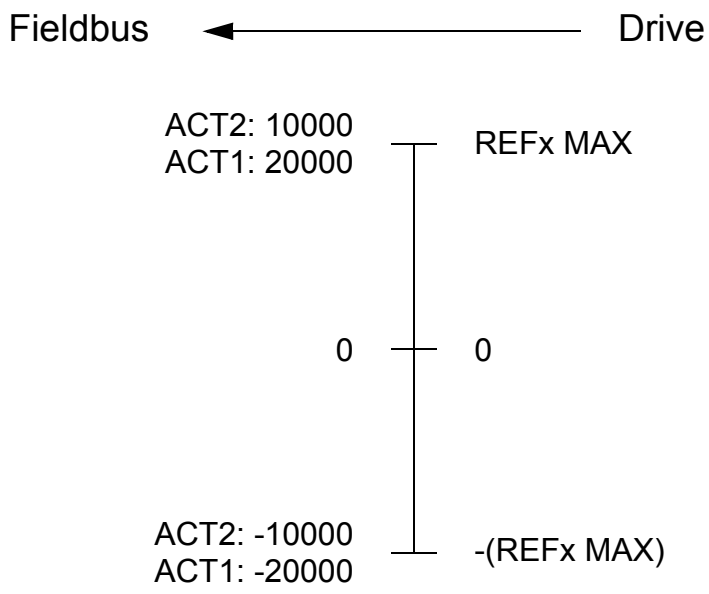


Table 13. The Control Word for the ABB Drives communication profile. The upper case boldface text refers to the states shown in Figure 15.

Bit	Name	Value	STATE/Description
0	OFF1_ CONTROL	1	Proceed to **READY TO OPERATE**.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2_ CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	OFF3_ CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. **Warning:** Ensure motor and driven machine can be stopped using this stop mode.
3	INHIBIT_ OPERATION	1	Proceed to **OPERATION ENABLED**. **Note:** Run enable signal must be active; see drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).

Bit	Name	Value	STATE/Description
5	RAMP_HOLD	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.
8 to 9	Reserved.		
10	REMOTE_ CMD	1	Fieldbus control enabled.
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control enabled. Reference and deceleration/ acceleration ramp are locked.
11	EXT_CTRL_ LOC	1	Select External Control Location EXT2. Effective if control location parameterised to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location parameterised to be selected from fieldbus.
12 to 15	Reserved.		

Table 14. The Status Word for the ABB Drives communication profile. The upper case boldface text refers to the states shown in Figure 15.

Bit	Name	Value	STATE/Description
0	RDY_ON	1	**READY TO SWITCH ON**.
		0	**NOT READY TO SWITCH ON**.
1	RDY_RUN	1	**READY TO OPERATE**.
		0	**OFF1 ACTIVE**.
2	RDY_REF	1	**OPERATION ENABLED**.
		0	**OPERATION INHIBITED**.
3	TRIPPED	1	**FAULT**.
		0	No fault.
4	OFF_2_STA	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	OFF_3_STA	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	SWC_ON_ INHIB	1	**SWITCH-ON INHIBITED**.
		0	–
7	ALARM	1	Warning/Alarm.
		0	No warning/alarm.
8	AT_ SETPOINT	1	**OPERATING**. Actual value equals reference = is within tolerance limits, i.e. in speed control, speed error is 10% max. of nominal motor speed.
		0	Actual value differs from reference = is outside tolerance limits.
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.

Bit	Name	Value	STATE/Description
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	EXT_CTRL_ LOC	1	External Control Location EXT2 selected.
		0	External Control Location EXT1 selected.
12	EXT_RUN_E NABLE	1	External Run Enable signal received
		0	No External Run Enable signal received
13 to 14	Reserved.		
15		1	Communication error detected by fieldbus adapter module.
		0	Fieldbus adapter communication OK.

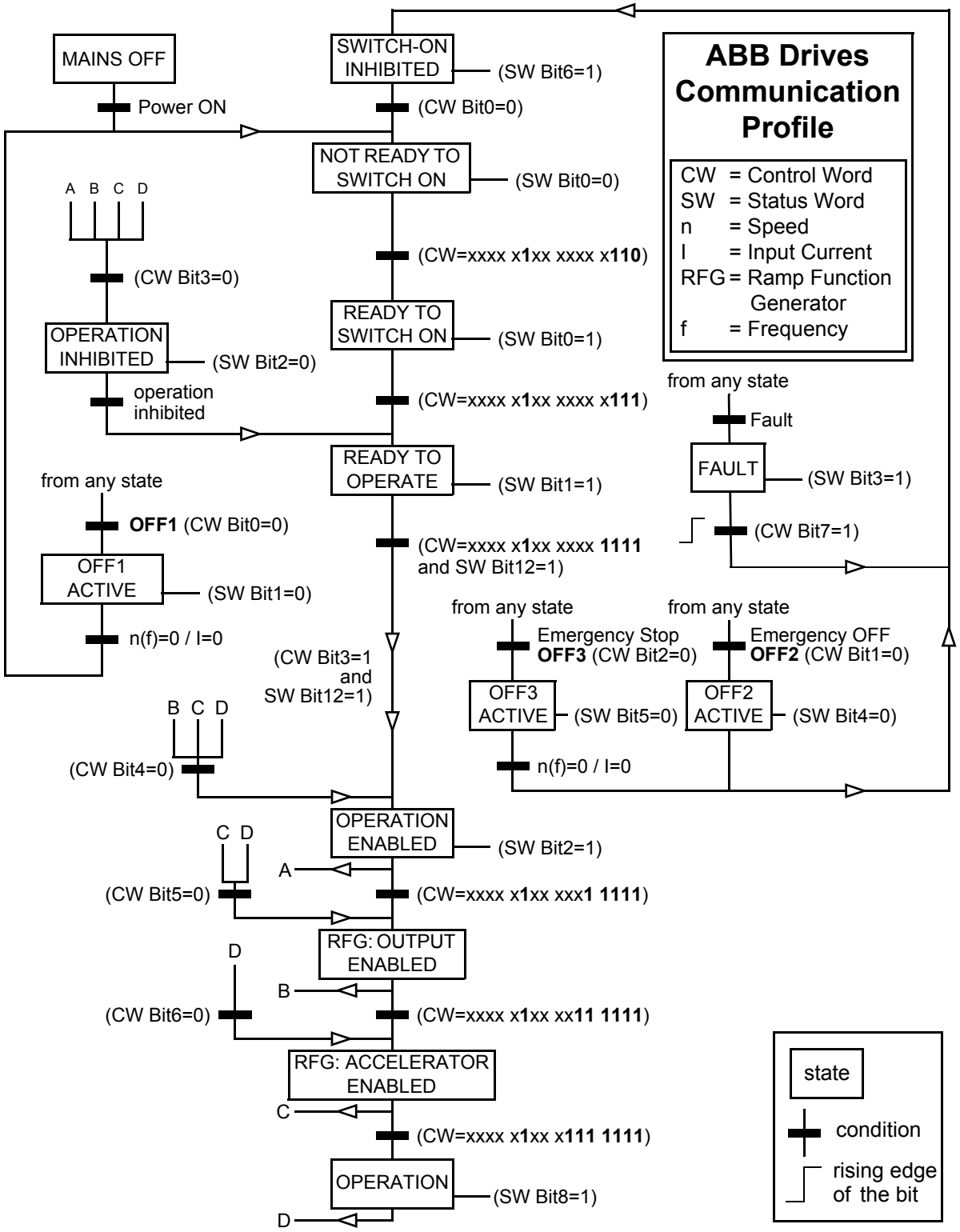


Figure 15. ABB State Transition Diagram

Communication

Overview

This chapter describes the DeviceNet communication protocol for the FDNA-01 and the configuration of the scanner. For detailed information on DeviceNet communication, refer to ODVA DeviceNet Specifications Release 2.0.

Introduction to DeviceNet

DeviceNet is a protocol based on CAN technology. CAN specifies the physical layer interface. DeviceNet specifies the wiring, and the data transfer through CAN.

The FDNA-01 is a device acting as a Group 2 only Server realizing the Predefined Master Slave Connection Set functionality. The Off-line Connection Set functionality and UCMM are not supported.

Object modelling and functional profiles

One of the main features of DeviceNet is object modelling. A group of objects can be described with a Functional Profile. The FDNA-01 realizes the ODVA AC/DC Drive Functional Profile with additional features.

Assembly objects

I/O Assembly Instances may also be referred to as Block Transfer of data. Intelligent devices realizing a Functional Profile, such as the FDNA-01, have several objects. Since it is not possible to transmit more than one object data through a single connection, it is practical and more efficient to group attributes from different objects into a single I/O connection (for example a Polled Connection) using the Assembly object. The Assembly object acts as a tool for grouping these attributes.

The Assembly selections described above are, in fact, instances of the Assembly object class. The FDNA-01 uses Static assemblies (in other words, fixed groupings of different object data only).

The following tables describe the assembly instances supported by the FDNA-01.

BASIC SPEED CONTROL assembly

The BASIC SPEED CONTROL assembly is defined by ODVA AC/DC Drive Profile. The format of the output assembly is:

Instance 20								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0						Fault Reset		Run Forward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							

The format of the input assembly is:

Instance 70								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0						Running Forward		Faulted
1								
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							

BASIC SPEED CONTROL PLUS DRIVE PARAMETERS assembly

The BASIC SPEED CONTROL PLUS DRIVE PARAMETERS assembly, defined by ABB, adds configurable drive parameters to the BASIC SPEED CONTROL assembly of the ODVA AC/DC Drive Profile.

The format of the output assembly is:

Instance 120								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0						Fault Reset		Run Forward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							
4	DATA OUT 1 Value (Low Byte)							
5	DATA OUT 1 Value (High Byte)							
6	DATA OUT 2 Value (Low Byte)							
7	DATA OUT 2 Value (High Byte)							
8	DATA OUT 3 Value (Low Byte)							
9	DATA OUT 3 Value (High Byte)							
10	DATA OUT 4 Value (Low Byte)							
11	DATA OUT 4 Value (High Byte)							
12	DATA OUT 5 Value (Low Byte)							
13	DATA OUT 5 Value (High Byte)							
14	DATA OUT 6 Value (Low Byte)							
15	DATA OUT 6 Value (High Byte)							
16	DATA OUT 7 Value (Low Byte)							
17	DATA OUT 7 Value (High Byte)							
18	DATA OUT 8 Value (Low Byte)							
19	DATA OUT 8 Value (High Byte)							
20	DATA OUT 9 Value (Low Byte)							
21	DATA OUT 9 Value (High Byte)							
22	DATA OUT 10 Value (Low Byte)							
23	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 170								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0						Running Forward		Faulted
1								
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	DATA IN 1 Value (Low Byte)							
5	DATA IN 1 Value (High Byte)							
6	DATA IN 2 Value (Low Byte)							
7	DATA IN 2 Value (High Byte)							
8	DATA IN 3 Value (Low Byte)							
9	DATA IN 3 Value (High Byte)							
10	DATA IN 4 Value (Low Byte)							
11	DATA IN 4 Value (High Byte)							
12	DATA IN 5 Value (Low Byte)							
13	DATA IN 5 Value (High Byte)							
14	DATA IN 6 Value (Low Byte)							
15	DATA IN 6 Value (High Byte)							
16	DATA IN 7 Value (Low Byte)							
17	DATA IN 7 Value (High Byte)							
18	DATA IN 8 Value (Low Byte)							
19	DATA IN 8 Value (High Byte)							
20	DATA IN 9 Value (Low Byte)							
21	DATA IN 9 Value (High Byte)							
22	DATA IN 10 Value (Low Byte)							
23	DATA IN 10 Value (High Byte)							

EXTENDED SPEED CONTROL assembly

The EXTENDED SPEED CONTROL assembly is defined by ODVA AC/DC Drive Profile. The format of the output assembly is:

Instance 21								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0		Net Ref	Net Ctrl			Fault Reset	Run Reverse	Run For-ward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							

The format of the input assembly is:

Instance 71								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	At Refer-ence	Ref From Net	Ctrl From Net	Ready	Run-ning Reverse	Run-ning Forward	Warning	Faulted
1	Drive State (See Table 11.)							
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							

EXTENDED SPEED CONTROL PLUS DRIVE PARAMETERS assembly

The EXTENDED SPEED CONTROL PLUS DRIVE PARAMETERS assembly, defined by ABB, adds configurable drive parameters to the EXTENDED SPEED CONTROL assembly of the ODVA AC/DC Drive Profile.

The format of the output assembly is:

Instance 121								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0		Net Ref	Net Ctl			Fault Reset	Run Reverse	Run Forward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							
4	DATA OUT 1 Value (Low Byte)							
5	DATA OUT 1 Value (High Byte)							
6	DATA OUT 2 Value (Low Byte)							
7	DATA OUT 2 Value (High Byte)							
8	DATA OUT 3 Value (Low Byte)							
9	DATA OUT 3 Value (High Byte)							
10	DATA OUT 4 Value (Low Byte)							
11	DATA OUT 4 Value (High Byte)							
12	DATA OUT 5 Value (Low Byte)							
13	DATA OUT 5 Value (High Byte)							
14	DATA OUT 6 Value (Low Byte)							
15	DATA OUT 6 Value (High Byte)							
16	DATA OUT 7 Value (Low Byte)							
17	DATA OUT 7 Value (High Byte)							
18	DATA OUT 8 Value (Low Byte)							
19	DATA OUT 8 Value (High Byte)							
20	DATA OUT 9 Value (Low Byte)							
21	DATA OUT 9 Value (High Byte)							
22	DATA OUT 10 Value (Low Byte)							
23	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 171								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	At Refer-ence	Ref From Net	Ctrl From Net	Ready	Running Reverse	Running Forward	Warning	Faulted
1	Drive State (See Table 11.)							
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	DATA IN 1 Value (Low Byte)							
5	DATA IN 1 Value (High Byte)							
6	DATA IN 2 Value (Low Byte)							
7	DATA IN 2 Value (High Byte)							
8	DATA IN 3 Value (Low Byte)							
9	DATA IN 3 Value (High Byte)							
10	DATA IN 4 Value (Low Byte)							
11	DATA IN 4 Value (High Byte)							
12	DATA IN 5 Value (Low Byte)							
13	DATA IN 5 Value (High Byte)							
14	DATA IN 6 Value (Low Byte)							
15	DATA IN 6 Value (High Byte)							
16	DATA IN 7 Value (Low Byte)							
17	DATA IN 7 Value (High Byte)							
18	DATA IN 8 Value (Low Byte)							
19	DATA IN 8 Value (High Byte)							
20	DATA IN 9 Value (Low Byte)							
21	DATA IN 9 Value (High Byte)							
22	DATA IN 10 Value (Low Byte)							
23	DATA IN 10 Value (High Byte)							

BASIC SPEED AND TORQUE CONTROL assembly

The BASIC SPEED AND TORQUE CONTROL assembly is defined by the ODVA AC/DC Drive Profile. The format of the output assembly is:

Instance 22								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0						Fault Reset		Run Forward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							
4	Torque Reference (Low Byte)							
5	Torque Reference (High Byte)							

The format of the input assembly is:

Instance 72								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0						Running Forward		Faulted
1								
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	Torque Actual (Low Byte)							
5	Torque Actual (High Byte)							

BASIC SPEED AND TORQUE CONTROL PLUS DRIVE PARAMETERS assembly

The BASIC SPEED AND TORQUE CONTROL PLUS DRIVE PARAMETERS assembly, defined by ABB, adds configurable drive parameters to the BASIC SPEED AND TORQUE CONTROL assembly of the ODVA AC/DC Drive Profile.

The format of the output assembly is:

Instance 122								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0						Fault Reset		Run For-ward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							
4	Torque Reference (Low Byte)							
5	Torque Reference (High Byte)							
6	DATA OUT 1 Value (Low Byte)							
7	DATA OUT 1 Value (High Byte)							
8	DATA OUT 2 Value (Low Byte)							
9	DATA OUT 2 Value (High Byte)							
10	DATA OUT 3 Value (Low Byte)							
11	DATA OUT 3 Value (High Byte)							
12	DATA OUT 4 Value (Low Byte)							
13	DATA OUT 4 Value (High Byte)							
14	DATA OUT 5 Value (Low Byte)							
15	DATA OUT 5 Value (High Byte)							
16	DATA OUT 6 Value (Low Byte)							
17	DATA OUT 6 Value (High Byte)							
18	DATA OUT 7 Value (Low Byte)							
19	DATA OUT 7 Value (High Byte)							
20	DATA OUT 8 Value (Low Byte)							
21	DATA OUT 8 Value (High Byte)							
22	DATA OUT 9 Value (Low Byte)							
23	DATA OUT 9 Value (High Byte)							
24	DATA OUT 10 Value (Low Byte)							
25	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 172								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0						Run-ning Forward		Faulted
1								
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	Torque Actual (Low Byte)							
5	Torque Actual (High Byte)							
6	DATA IN 1 Value (Low Byte)							
7	DATA IN 1 Value (High Byte)							
8	DATA IN 2 Value (Low Byte)							
9	DATA IN 2 Value (High Byte)							
10	DATA IN 3 Value (Low Byte)							
11	DATA IN 3 Value (High Byte)							
12	DATA IN 4 Value (Low Byte)							
13	DATA IN 4 Value (High Byte)							
14	DATA IN 5 Value (Low Byte)							
15	DATA IN 5 Value (High Byte)							
16	DATA IN 6 Value (Low Byte)							
17	DATA IN 6 Value (High Byte)							
18	DATA IN 7 Value (Low Byte)							
19	DATA IN 7 Value (High Byte)							
20	DATA IN 8 Value (Low Byte)							
21	DATA IN 8 Value (High Byte)							
22	DATA IN 9 Value (Low Byte)							
23	DATA IN 9 Value (High Byte)							
24	DATA IN 10 Value (Low Byte)							
25	DATA IN 10 Value (High Byte)							

EXTENDED SPEED AND TORQUE CONTROL assembly

The EXTENDED SPEED AND TORQUE CONTROL assembly is defined by the ODVA AC/DC Drive Profile. The format of the output assembly is:

Instance 23								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0		Net Ref	Net Ctl			Fault Reset	Run Reverse	Run For-ward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							
4	Torque Reference (Low Byte)							
5	Torque Reference (High Byte)							

The format of the input assembly is:

Instance 73								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	At Refer-ence	Ref From Net	Ctrl From Net	Ready	Running Reverse	Running Forward	Warning	Faulted
1	Drive State (See Table 11.)							
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	Torque Actual (Low Byte)							
5	Torque Actual (High Byte)							

EXTENDED SPEED AND TORQUE CONTROL PLUS DRIVE PARAMETERS assembly

The EXTENDED SPEED AND TORQUE CONTROL PLUS DRIVE PARAMETERS assembly, defined by ABB, adds configurable drive parameters to the EXTENDED SPEED AND TORQUE CONTROL assembly of the ODVA AC/DC Drive Profile.

The format of the output assembly is:

Instance 123								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0		NetRef	NetCtl			Fault Reset	Run Reverse	Run Forward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							
4	Torque Reference (Low Byte)							
5	Torque Reference (High Byte)							
6	DATA OUT 1 Value (Low Byte)							
7	DATA OUT 1 Value (High Byte)							
8	DATA OUT 2 Value (Low Byte)							
9	DATA OUT 2 Value (High Byte)							
10	DATA OUT 3 Value (Low Byte)							
11	DATA OUT 3 Value (High Byte)							
12	DATA OUT 4 Value (Low Byte)							
13	DATA OUT 4 Value (High Byte)							
14	DATA OUT 5 Value (Low Byte)							
15	DATA OUT 5 Value (High Byte)							
16	DATA OUT 6 Value (Low Byte)							
17	DATA OUT 6 Value (High Byte)							
18	DATA OUT 7 Value (Low Byte)							
19	DATA OUT 7 Value (High Byte)							
20	DATA OUT 8 Value (Low Byte)							
21	DATA OUT 8 Value (High Byte)							
22	DATA OUT 9 Value (Low Byte)							
23	DATA OUT 9 Value (High Byte)							
24	DATA OUT 10 Value (Low Byte)							
25	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 173								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	At Refer-ence	Ref From Net	Ctrl From Net	Ready	Running Reverse	Running Forward	Warn-ing	Faulted
1	Drive State (See Table 11.)							
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	Torque Actual (Low Byte)							
5	Torque Actual (High Byte)							
6	DATA IN 1 Value (Low Byte)							
7	DATA IN 1 Value (High Byte)							
8	DATA IN 2 Value (Low Byte)							
9	DATA IN 2 Value (High Byte)							
10	DATA IN 3 Value (Low Byte)							
11	DATA IN 3 Value (High Byte)							
12	DATA IN 4 Value (Low Byte)							
13	DATA IN 4 Value (High Byte)							
14	DATA IN 5 Value (Low Byte)							
15	DATA IN 5 Value (High Byte)							
16	DATA IN 6 Value (Low Byte)							
17	DATA IN 6 Value (High Byte)							
18	DATA IN 7 Value (Low Byte)							
19	DATA IN 7 Value (High Byte)							
20	DATA IN 8 Value (Low Byte)							
21	DATA IN 8 Value (High Byte)							
22	DATA IN 9 Value (Low Byte)							
23	DATA IN 9 Value (High Byte)							
24	DATA IN 10 Value (Low Byte)							
25	DATA IN 10 Value (High Byte)							

ABB DRIVES PROFILE SET SPEED assembly

The ABB DRIVES PROFILE WITH SET SPEED assembly is defined by ABB. The format of the output assembly is:

Instance 801								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Reset	Ramp in Zero	Ramp Hold	Ramp Out Zero	Inhibit Opera-tion	Off 3 Control	Off 2 Control	Off 1 Control
1					Ext Ctrl Loc	Remote Cmd		
2	Set Speed (Low Byte)							
3	Set Speed (High Byte)							

The format of the input assembly is:

Instance 851								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Alarm	Swc On Inhib	Off 3 Sta	Off 2 Sta	Tripped	Rdy Ref	Rdy Run	Rdy On
1	Field-bus Error			Ext Run Enable	Ext Ctrl Loc	Above Limit	Remote	At Set-point
2	Actual Speed (Low Byte)							
3	Actual Speed (High Byte)							

ABB DRIVES PROFILE WITH SET SPEED PLUS DRIVE PARAMETERS assembly

The ABB DRIVES PROFILE WITH SET SPEED PLUS DRIVE PARAMETERS assembly, defined by ABB, adds configurable drive parameters to the ABB DRIVES PROFILE WITH SET SPEED of the ABB Drives Profile.

The format of the output assembly is:

Instance 901								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Reset	Ramp in Zero	Ramp Hold	Ramp Out Zero	Inhibit Opera-tion	Off 3 Control	Off 2 Control	Off 1 Control
1					Ext Ctrl Loc	Remote Cmd		
2	Set Speed (Low Byte)							
3	Set Speed (High Byte)							
4	DATA OUT 1 Value (Low Byte)							
5	DATA OUT 1 Value (High Byte)							
6	DATA OUT 2 Value (Low Byte)							
7	DATA OUT 2 Value (High Byte)							
8	DATA OUT 3 Value (Low Byte)							
9	DATA OUT 3 Value (High Byte)							
10	DATA OUT 4 Value (Low Byte)							
11	DATA OUT 4 Value (High Byte)							
12	DATA OUT 5 Value (Low Byte)							
13	DATA OUT 5 Value (High Byte)							
14	DATA OUT 6 Value (Low Byte)							
15	DATA OUT 6 Value (High Byte)							
16	DATA OUT 7 Value (Low Byte)							
17	DATA OUT 7 Value (High Byte)							
18	DATA OUT 8 Value (Low Byte)							
19	DATA OUT 8 Value (High Byte)							
20	DATA OUT 9 Value (Low Byte)							
21	DATA OUT 9 Value (High Byte)							
22	DATA OUT 10 Value (Low Byte)							
23	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 951								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Alarm	Swc On Inhib	Off 3 Sta	Off 2 Sta	Tripped	Rdy Ref	Rdy Run	Rdy On
1	Field-bus Error			Ext Run Enable	Ext Ctrl Loc	Above Limit	Remote	At Set-point
2	Actual Speed (Low Byte)							
3	Actual Speed (High Byte)							
4	DATA IN 1 Value (Low Byte)							
5	DATA IN 1 Value (Low Byte)							
6	DATA IN 1 Value (High Byte)							
7	DATA IN 2 Value (Low Byte)							
8	DATA IN 2 Value (High Byte)							
9	DATA IN 3 Value (Low Byte)							
10	DATA IN 3 Value (High Byte)							
11	DATA IN 4 Value (Low Byte)							
12	DATA IN 4 Value (High Byte)							
13	DATA IN 5 Value (Low Byte)							
14	DATA IN 5 Value (High Byte)							
15	DATA IN 6 Value (Low Byte)							
16	DATA IN 6 Value (High Byte)							
17	DATA IN 7 Value (Low Byte)							
18	DATA IN 7 Value (High Byte)							
19	DATA IN 8 Value (Low Byte)							
20	DATA IN 8 Value (High Byte)							
21	DATA IN 9 Value (Low Byte)							
22	DATA IN 9 Value (High Byte)							
23	DATA IN 10 Value (Low Byte)							

ABB DRIVES PROFILE WITH SET SPEED AND SET TORQUE assembly

The ABB DRIVES PROFILE WITH SET SPEED AND SET TORQUE assembly is defined by ABB. The format of the output assembly is:

Instance 802								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Reset	Ramp in Zero	Ramp Hold	Ramp Out Zero	Inhibit Opera-tion	Off 3 Control	Off 2 Control	Off 1 Control
1					Ext Ctrl Loc	Remote Cmd		
2	Set Speed (Low Byte)							
3	Set Speed (High Byte)							
4	Set Torque (Low Byte)							
5	Set Torque (High Byte)							

The format of the input assembly is:

Instance 852								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Alarm	Swc On Inhib	Off 3 Sta	Off 2 Sta	Tripped	Rdy Ref	Rdy Run	Rdy On
1	Field-bus Error			Ext Run Enable	Ext Ctrl Loc	Above Limit	Remote	At Set-point
2	Actual Speed (Low Byte)							
3	Actual Speed (High Byte)							
4	Actual Torque (Low Byte)							
5	Actual Torque (High Byte)							

ABB DRIVES PROFILE WITH SET SPEED AND SET TORQUE PLUS DRIVE PARAMETERS assembly

The ABB DRIVES PROFILE WITH SET SPEED AND SET TORQUE PLUS DRIVE PARAMETERS assembly, defined by ABB, adds configurable drive parameters to the ABB DRIVES PROFILE WITH SET SPEED AND SET TORQUE of the ABB Drives Profile.

The format of the output assembly is:

Instance 902								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Reset	Ramp in Zero	Ramp Hold	Ramp Out Zero	Inhibit Opera-tion	Off 3 Control	Off 2 Control	Off 1 Control
1					Ext Ctrl Loc	Remote Cmd		
2	Set Speed (Low Byte)							
3	Set Speed (High Byte)							
4	Set Torque (Low Byte)							
5	Set Torque (High Byte)							
6	DATA OUT 1 Value (Low Byte)							
7	DATA OUT 1 Value (High Byte)							
8	DATA OUT 2 Value (Low Byte)							
9	DATA OUT 2 Value (High Byte)							
10	DATA OUT 3 Value (Low Byte)							
11	DATA OUT 3 Value (High Byte)							
12	DATA OUT 4 Value (Low Byte)							
13	DATA OUT 4 Value (High Byte)							
14	DATA OUT 5 Value (Low Byte)							
15	DATA OUT 5 Value (High Byte)							
16	DATA OUT 6 Value (Low Byte)							
17	DATA OUT 6 Value (High Byte)							
18	DATA OUT 7 Value (Low Byte)							
19	DATA OUT 7 Value (High Byte)							
20	DATA OUT 8 Value (Low Byte)							
21	DATA OUT 8 Value (High Byte)							
22	DATA OUT 9 Value (Low Byte)							
23	DATA OUT 9 Value (High Byte)							
24	DATA OUT 10 Value (Low Byte)							
25	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 952								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Alarm	Swc On Inhib	Off 3 Sta	Off 2 Sta	Tripped	Rdy Ref	Rdy Run	Rdy On
1	Field-bus Error			Ext Run Enable	Ext Ctrl Loc	Above Limit	Remote	At Set-point
2	Actual Speed (Low Byte)							
3	Actual Speed (High Byte)							
4	Actual Torque (Low Byte)							
5	Actual Torque (High Byte)							
6	DATA IN 1 Value (Low Byte)							
7	DATA IN 1 Value (High Byte)							
8	DATA IN 2 Value (Low Byte)							
9	DATA IN 2 Value (High Byte)							
10	DATA IN 3 Value (Low Byte)							
11	DATA IN 3 Value (High Byte)							
12	DATA IN 4 Value (Low Byte)							
13	DATA IN 4 Value (High Byte)							
14	DATA IN 5 Value (Low Byte)							
15	DATA IN 5 Value (High Byte)							
16	DATA IN 6 Value (Low Byte)							
17	DATA IN 6 Value (High Byte)							
18	DATA IN 7 Value (Low Byte)							
19	DATA IN 7 Value (High Byte)							
20	DATA IN 8 Value (Low Byte)							
21	DATA IN 8 Value (High Byte)							
22	DATA IN 9 Value (Low Byte)							
23	DATA IN 9 Value (High Byte)							
24	DATA IN 10 Value (Low Byte)							

Instance 952								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
25	DATA IN 10 Value (High Byte)							

TRANSPARENT16 WITH ONE assembly

The TRANSPARENT16 WITH ONE assembly, defined by ABB, provides unaltered 16-bit access to the configured drive profile.

The format of the output assembly is:

Instance 811								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 16-bit Control Word (Low Byte)							
1	Drive Profile 16-bit Control Word (High Byte)							
2	Drive Profile 16-bit Reference 1 Word (Low Byte)							
3	Drive Profile 16-bit Reference 1 Word (High Byte)							

The format of the input assembly is:

Instance 861								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 16-bit Status Word (Low Byte)							
1	Drive Profile 16-bit Status Word (High Byte)							
2	Drive Profile 16-bit Actual 1 Word (Low Byte)							
3	Drive Profile 16-bit Actual 1 Word (High Byte)							

TRANSPARENT16 WITH ONE assembly PLUS DRIVE PARAMETERS

The TRANSPARENT16 WITH ONE assembly PLUS DRIVE PARAMETERS, defined by ABB, adds configurable drive parameters to the TRANSPARENT16 WITH ONE assembly.

The format of the output assembly is:

Instance 911								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 16-bit Control Word (Low Byte)							
1	Drive Profile 16-bit Control Word (High Byte)							
2	Drive Profile 16-bit Reference 1 Word (Low Byte)							
3	Drive Profile 16-bit Reference 1 Word (High Byte)							
4	DATA OUT 1 Value (Low Byte)							
5	DATA OUT 1 Value (High Byte)							
6	DATA OUT 2 Value (Low Byte)							
7	DATA OUT 2 Value (High Byte)							
8	DATA OUT 3 Value (Low Byte)							
9	DATA OUT 3 Value (High Byte)							
10	DATA OUT 4 Value (Low Byte)							
11	DATA OUT 4 Value (High Byte)							
12	DATA OUT 5 Value (Low Byte)							
13	DATA OUT 5 Value (High Byte)							
14	DATA OUT 6 Value (Low Byte)							
15	DATA OUT 6 Value (High Byte)							
16	DATA OUT 7 Value (Low Byte)							
17	DATA OUT 7 Value (High Byte)							
18	DATA OUT 8 Value (Low Byte)							
19	DATA OUT 8 Value (High Byte)							
20	DATA OUT 9 Value (Low Byte)							
21	DATA OUT 9 Value (High Byte)							
22	DATA OUT 10 Value (Low Byte)							
23	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 961								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 16-bit Status Word (Low Byte)							
1	Drive Profile 16-bit Status Word (High Byte)							
2	Drive Profile 16-bit Actual 1 Word (Low Byte)							
3	Drive Profile 16-bit Actual 1 Word (High Byte)							
4	DATA IN 1 Value (Low Byte)							
5	DATA IN 1 Value (High Byte)							
6	DATA IN 2 Value (Low Byte)							
7	DATA IN 2 Value (High Byte)							
8	DATA IN 3 Value (Low Byte)							
9	DATA IN 3 Value (High Byte)							
10	DATA IN 4 Value (Low Byte)							
11	DATA IN 4 Value (High Byte)							
12	DATA IN 5 Value (Low Byte)							
13	DATA IN 5 Value (High Byte)							
14	DATA IN 6 Value (Low Byte)							
15	DATA IN 6 Value (High Byte)							
16	DATA IN 7 Value (Low Byte)							
17	DATA IN 7 Value (High Byte)							
18	DATA IN 8 Value (Low Byte)							
19	DATA IN 8 Value (High Byte)							
20	DATA IN 9 Value (Low Byte)							
21	DATA IN 9 Value (High Byte)							
22	DATA IN 10 Value (Low Byte)							
23	DATA IN 10 Value (High Byte)							

TRANSPARENT16 WITH TWO assembly

The TRANSPARENT16 WITH TWO assembly, defined by ABB, provides unaltered 16-bit access to the configured drive profile.

The format of the output assembly is:

Instance 812								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 16-bit Control Word (Low Byte)							
1	Drive Profile 16-bit Control Word (High Byte)							
2	Drive Profile 16-bit Reference 1 Word (Low Byte)							
3	Drive Profile 16-bit Reference 1 Word (High Byte)							
4	Drive Profile16-bit Reference 2 Word (Low Byte)							
5	Drive Profile 16-bit Reference 2 Word (High Byte)							

The format of the input assembly is:

Instance 862								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 16-bit Status Word (Low Byte)							
1	Drive Profile 16-bit Status Word (High Byte)							
2	Drive Profile 16-bit Actual 1 Word (Low Byte)							
3	Drive Profile 16-bit Actual 1 Word (High Byte)							
4	Drive Profile16-bit Actual 2 Word (Low Byte)							
5	Drive Profile 16-bit Actual 2 Word (High Byte)							

TRANSPARENT16 WITH TWO assembly PLUS DRIVE PARAMETERS

The TRANSPARENT16 WITH TWO assembly PLUS DRIVE PARAMETERS, defined by ABB, adds configurable drive parameters to the TRANSPARENT16 WITH TWO assembly.

The format of the output assembly is:

Instance 912								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 16-bit Control Word (Low Byte)							
1	Drive Profile 16-bit Control Word (High Byte)							
2	Drive Profile 16-bit Reference 1 Word (Low Byte)							
3	Drive Profile 16-bit Reference 1 Word (High Byte)							
4	Drive Profile 16-bit Reference 2 Word (Low Byte)							
5	Drive Profile 16-bit Reference 2 Word (High Byte)							
6	DATA OUT 1 Value (Low Byte)							
7	DATA OUT 1 Value (High Byte)							
8	DATA OUT 2 Value (Low Byte)							
9	DATA OUT 2 Value (High Byte)							
10	DATA OUT 3 Value (Low Byte)							
11	DATA OUT 3 Value (High Byte)							
12	DATA OUT 4 Value (Low Byte)							
13	DATA OUT 4 Value (High Byte)							
14	DATA OUT 5 Value (Low Byte)							
15	DATA OUT 5 Value (High Byte)							
16	DATA OUT 6 Value (Low Byte)							
17	DATA OUT 6 Value (High Byte)							
18	DATA OUT 7 Value (Low Byte)							
19	DATA OUT 7 Value (High Byte)							
20	DATA OUT 8 Value (Low Byte)							
21	DATA OUT 8 Value (High Byte)							
22	DATA OUT 9 Value (Low Byte)							
23	DATA OUT 9 Value (High Byte)							
24	DATA OUT 10 Value (Low Byte)							
25	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 962								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 16-bit Status Word (Low Byte)							
1	Drive Profile 16-bit Status Word (High Byte)							
2	Drive Profile 16-bit Actual 1 Word (Low Byte)							
3	Drive Profile 16-bit Actual 1 Word (High Byte)							
4	Drive Profile 16-bit Actual 2 Word (Low Byte)							
5	Drive Profile 16-bit Actual 2 Word (High Byte)							
6	DATA IN 1 Value (Low Byte)							
7	DATA IN 1 Value (High Byte)							
8	DATA IN 2 Value (Low Byte)							
9	DATA IN 2 Value (High Byte)							
10	DATA IN 3 Value (Low Byte)							
11	DATA IN 3 Value (High Byte)							
12	DATA IN 4 Value (Low Byte)							
13	DATA IN 4 Value (High Byte)							
14	DATA IN 5 Value (Low Byte)							
15	DATA IN 5 Value (High Byte)							
16	DATA IN 6 Value (Low Byte)							
17	DATA IN 6 Value (High Byte)							
18	DATA IN 7 Value (Low Byte)							
19	DATA IN 7 Value (High Byte)							
20	DATA IN 8 Value (Low Byte)							
21	DATA IN 8 Value (High Byte)							
22	DATA IN 9 Value (Low Byte)							
23	DATA IN 9 Value (High Byte)							
24	DATA IN 10 Value (Low Byte)							
25	DATA IN 10 Value (High Byte)							

TRANSPARENT32 WITH ONE assembly

The TRANSPARENT32 WITH ONE assembly, defined by ABB, provides unaltered 32-bit access to the configured drive profile.

The format of the output assembly is:

Instance 821								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 32-bit Control Word (Low Byte)							
1	Drive Profile 32-bit Control Word							
2	Drive Profile 32-bit Control Word							
3	Drive Profile 32-bit Control Word (High Byte)							
4	Drive Profile 32-bit Reference 1 Word (Low Byte)							
5	Drive Profile 32-bit Reference 1 Word							
6	Drive Profile 32-bit Reference 1 Word							
7	Drive Profile 32-bit Reference 1 Word (High Byte)							

The format of the input assembly is:

Instance 871								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 32-bit Status Word (Low Byte)							
1	Drive Profile 32-bit Status Word							
2	Drive Profile 32-bit Status Word							
3	Drive Profile 32-bit Status Word (High Byte)							
4	Drive Profile 32-bit Actual 1 Word (Low Byte)							
5	Drive Profile 32-bit Actual 1 Word							
6	Drive Profile 32-bit Actual 1 Word							
7	Drive Profile 32-bit Actual 1 Word (High Byte)							

TRANSPARENT32 WITH ONE assembly PLUS DRIVE PARAMETERS

The TRANSPARENT32 WITH ONE assembly PLUS DRIVE PARAMETERS, defined by ABB, adds configurable drive parameters to the TRANSPARENT32 WITH ONE assembly.

The format of the output assembly is:

Instance 921								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 32-bit Control Word (Low Byte)							
1	Drive Profile 32-bit Control Word							
2	Drive Profile 32-bit Control Word							
3	Drive Profile 32-bit Control Word (High Byte)							
4	Drive Profile 32-bit Reference 1 Word (Low Byte)							
5	Drive Profile 32-bit Reference 1 Word							
6	Drive Profile 32-bit Reference 1 Word							
7	Drive Profile 32-bit Reference 1 Word (High Byte)							
8	DATA OUT 1 Value (Low Byte)							
9	DATA OUT 1 Value (High Byte)							
10	DATA OUT 2 Value (Low Byte)							
11	DATA OUT 2 Value (High Byte)							
12	DATA OUT 3 Value (Low Byte)							
13	DATA OUT 3 Value (High Byte)							
14	DATA OUT 4 Value (Low Byte)							
15	DATA OUT 4 Value (High Byte)							
16	DATA OUT 5 Value (Low Byte)							
17	DATA OUT 5 Value (High Byte)							
18	DATA OUT 6 Value (Low Byte)							
19	DATA OUT 6 Value (High Byte)							
20	DATA OUT 7 Value (Low Byte)							
21	DATA OUT 7 Value (High Byte)							
22	DATA OUT 8 Value (Low Byte)							
23	DATA OUT 8 Value (High Byte)							
24	DATA OUT 9 Value (Low Byte)							
25	DATA OUT 9 Value (High Byte)							
26	DATA OUT 10 Value (Low Byte)							
27	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 971								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 32-bit Status Word (Low Byte)							
1	Drive Profile 32-bit Status Word							
2	Drive Profile 32-bit Status Word							
3	Drive Profile 32-bit Status Word (High Byte)							
4	Drive Profile 32-bit Actual 1 Word (Low Byte)							
5	Drive Profile 32-bit Actual 1 Word (High Byte)							
6	Drive Profile 32-bit Actual 1 Word							
7	Drive Profile 32-bit Actual 1 Word (High Byte)							
8	DATA IN 1 Value (Low Byte)							
9	DATA IN 1 Value (High Byte)							
10	DATA IN 2 Value (Low Byte)							
11	DATA IN 2 Value (High Byte)							
12	DATA IN 3 Value (Low Byte)							
13	DATA IN 3 Value (High Byte)							
14	DATA IN 4 Value (Low Byte)							
15	DATA IN 4 Value (High Byte)							
16	DATA IN 5 Value (Low Byte)							
17	DATA IN 5 Value (High Byte)							
18	DATA IN 6 Value (Low Byte)							
19	DATA IN 6 Value (High Byte)							
20	DATA IN 7 Value (Low Byte)							
21	DATA IN 7 Value (High Byte)							
22	DATA IN 8 Value (Low Byte)							
23	DATA IN 8 Value (High Byte)							
24	DATA IN 9 Value (Low Byte)							
25	DATA IN 9 Value (High Byte)							
26	DATA IN 10 Value (Low Byte)							
27	DATA IN 10 Value (High Byte)							

TRANSPARENT32 WITH TWO assembly

The TRANSPARENT32 WITH TWO assembly, defined by ABB, provides unaltered 32-bit access to the configured drive profile.

The format of the output assembly is:

Instance 822								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 32-bit Control Word (Low Byte)							
1	Drive Profile 32-bit Control Word							
2	Drive Profile 32-bit Control Word							
3	Drive Profile 32-bit Control Word (High Byte)							
4	Drive Profile 32-bit Reference 1 Word (Low Byte)							
5	Drive Profile 32-bit Reference 1 Word							
6	Drive Profile 32-bit Reference 1 Word							
7	Drive Profile 32-bit Reference 1 Word (High Byte)							
8	Drive Profile 32-bit Reference 2 Word (Low Byte)							
9	Drive Profile 32-bit Reference 2 Word							
10	Drive Profile 32-bit Reference 2 Word							
11	Drive Profile 32-bit Reference 2 Word (High Byte)							

The format of the input assembly is:

Instance 872								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 32-bit Status Word (Low Byte)							
1	Drive Profile 32-bit Status Word							
2	Drive Profile 32-bit Status Word							
3	Drive Profile 32-bit Status Word (High Byte)							
4	Drive Profile 32-bit Actual 1 Word (Low Byte)							
5	Drive Profile 32-bit Actual 1 Word							
6	Drive Profile 32-bit Actual 1 Word							
7	Drive Profile 32-bit Actual 1 Word (High Byte)							
8	Drive Profile 32-bit Actual 2 Word (Low Byte)							
9	Drive Profile 32-bit Actual 2 Word							
10	Drive Profile 32-bit Actual 2 Word							
11	Drive Profile 32-bit Actual 2 Word (High Byte)							

TRANSPARENT32 WITH TWO assembly PLUS DRIVE PARAMETERS

The TRANSPARENT32 WITH TWO assembly PLUS DRIVE PARAMETERS, defined by ABB, adds configurable drive parameters to the TRANSPARENT32 WITH TWO assembly.

The format of the output assembly is:

Instance 922								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 32-bit Control Word (Low Byte)							
1	Drive Profile 32-bit Control Word							
2	Drive Profile 32-bit Control Word							
3	Drive Profile 32-bit Control Word (High Byte)							
4	Drive Profile 32-bit Reference 1 Word (Low Byte)							
5	Drive Profile 32-bit Reference 1 Word							
6	Drive Profile 32-bit Reference 1 Word							
7	Drive Profile 32-bit Reference 1 Word (High Byte)							

Instance 922								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
8	Drive Profile 32-bit Reference 2 Word (Low Byte)							
9	Drive Profile 32-bit Reference 2 Word							
10	Drive Profile 32-bit Reference 2 Word							
11	Drive Profile 32-bit Reference 2 Word (High Byte)							
12	DATA OUT 1 Value (Low Byte)							
13	DATA OUT 1 Value (High Byte)							
14	DATA OUT 2 Value (Low Byte)							
15	DATA OUT 2 Value (High Byte)							
16	DATA OUT 3 Value (Low Byte)							
17	DATA OUT 3 Value (High Byte)							
18	DATA OUT 4 Value (Low Byte)							
19	DATA OUT 4 Value (High Byte)							
20	DATA OUT 5 Value (Low Byte)							
21	DATA OUT 5 Value (High Byte)							
22	DATA OUT 6 Value (Low Byte)							
23	DATA OUT 6 Value (High Byte)							
24	DATA OUT 7 Value (Low Byte)							
25	DATA OUT 7 Value (High Byte)							
26	DATA OUT 8 Value (Low Byte)							
27	DATA OUT 8 Value (High Byte)							
28	DATA OUT 9 Value (Low Byte)							
29	DATA OUT 9 Value (High Byte)							
30	DATA OUT 10 Value (Low Byte)							
31	DATA OUT 10 Value (High Byte)							

The format of the input assembly is:

Instance 972								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	Drive Profile 32-bit Status Word (Low Byte)							
1	Drive Profile 32-bit Status Word							
2	Drive Profile 32-bit Status Word							
3	Drive Profile 32-bit Status Word (High Byte)							
4	Drive Profile 32-bit Actual 1 Word (Low Byte)							
5	Drive Profile 32-bit Actual 1 Word							
6	Drive Profile 32-bit Actual 1 Word							
7	Drive Profile 32-bit Actual 1 Word (High Byte)							
8	Drive Profile 32-bit Actual 2 Word (Low Byte)							
9	Drive Profile 32-bit Actual 2 Word							
10	Drive Profile 32-bit Actual 2 Word							
11	Drive Profile 32-bit Actual 2 Word (High Byte)							
12	DATA IN 1 Value (Low Byte)							
13	DATA IN 1 Value (High Byte)							
14	DATA IN 2 Value (Low Byte)							
15	DATA IN 2 Value (High Byte)							
16	DATA IN 3 Value (Low Byte)							
17	DATA IN 3 Value (High Byte)							
18	DATA IN 4 Value (Low Byte)							
19	DATA IN 4 Value (High Byte)							
20	DATA IN 5 Value (Low Byte)							
21	DATA IN 5 Value (High Byte)							
22	DATA IN 6 Value (Low Byte)							
23	DATA IN 6 Value (High Byte)							
24	DATA IN 7 Value (Low Byte)							
25	DATA IN 7 Value (High Byte)							
26	DATA IN 8 Value (Low Byte)							
27	DATA IN 8 Value (High Byte)							
28	DATA IN 9 Value (Low Byte)							

Instance 972								
Byte	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
29	DATA IN 9 Value (High Byte)							
30	DATA IN 10 Value (Low Byte)							
31	DATA IN 10 Value (High Byte)							

Class objects

Legend:	Data type
UINT8	Unsigned Integer 8 bit
UINT16	Unsigned Integer 16 bit
SINT16	Signed Integer 16 bit
UINT32	Unsigned Integer 32 bit
BOOL	Boolean value

Note: The FDNA-01 DeviceNet Adapter Module is designed to provide DeviceNet communications for a variety of drives with different capabilities. Default, minimum and maximum values for attributes necessarily vary based upon the capabilities of the drive to which the module is attached and are not documented herein. Default, minimum and maximum values for attributes may be found in the:
- User's Manual for the drive
- Electronic Data Sheet Files (EDS) for the drive.

Be aware that the units of attributes may differ from those of parameters documented elsewhere and those differences should be considered when interfacing to the drive via the module.

Identity Object, Class 01h

This object provides identification of and general information about the device.

Class Attributes

#	Attribute name	Services	Description	Data type
1	Revision	Get	Revision of the Identity Object	Array of UINT8

Instance Attributes

#	Attribute name	Services	Description	Data type
1	Vendor ID	Get	Identification of the device vendor.	UINT16
2	Device Type	Get	Identification of the general product type	UINT16
3	Product Code	Get	Assigned vendor code to describe the device	UINT16
4	Revision	Get	Revision of the item the Identity Object represents	Array[UINT8 UINT8]
5	Status	Get	Summary Status of the Device	UINT16
6	ODVA Serial Number	Get	Serial Number of the DeviceNet module	UINT32
7	Product Name	Get	Product identification. Max 32 characters.	Short String
8	State	Get	Present state of device.	USINT

Attribute explanations

Vendor ID
Vendor IDs are managed by the Open DeviceNet Vendor Association, Inc. (ODVA). The ABB Vendor ID is 46.

Device Type
The list of device types is managed by ODVA. It is used to identify the device profile that a particular product is using.
E.g. 2 = AC drive, 13 = DC drive

Product Code
Every ABB drive type or application of the drive has a dedicated product code.

Revision
Revision attribute, which consists of Major and Minor Revisions, identifies the Revision of the item the Identity Object is representing.

Status
This attribute represents the current status of the entire device. Its value changes as the state of the device changes. The Status attribute is a WORD, with the following bit definitions:

Bit(s)	Type/Name	Definition
0	Owned	TRUE indicates the device (or an object within the device) has an owner. Within the Master/ Slave paradigm the setting of this bit means that the Predefined Master/Slave Connection Set has been allocated to a master. Outside the Master/Slave paradigm the meaning of this bit is to be defined.
1		Reserved, set to 0.
2	Configured	TRUE indicates the application of the device has been configured to do something that differs from the “out–of–box” default. This does not include configuration of the communications.
3		Reserved, set to 0.
4,5,6,7		Vendor-specific.
8	Minor Recoverable Fault	TRUE indicates the device detected a recoverable problem. The problem does not cause the device to go into a faulted state.
9	Minor Unrecoverable Fault	TRUE indicates the device detected a unrecoverable problem. The problem does not cause the device to go into a faulted state.
10	Major Recoverable Fault	TRUE indicates the device detected a problem which caused the device to go into the “Major Recoverable Fault” state.
11	Major Unrecoverable Fault	TRUE indicates the device detected a problem which caused the device to go into the “Major Unrecoverable Fault” state.

Bit(s)	Type/Name	Definition
12,13,14,15		Reserved, set to 0.

ODVA Serial Number:
This attribute is a number used in conjunction with the Vendor ID to form a unique identifier for each device on DeviceNet. The value of this attribute is 02000000h plus the SERNO value from the device label.

Product Name:
This text string should represent a short description of the product/ product family represented by the product code in attribute 3.

State:
Represents current state of Identity Object**.**

Value	State
0	Nonexistent
1	Device Self Testing
2	Standby
3	Operational
4	Major Unrecoverable Fault
5	Minor Unrecoverable Fault

DeviceNet Object, Class 03h

The DeviceNet Object provides the configuration and status of a DeviceNet port. Each DeviceNet product must support one (and only one) DeviceNet object per physical connection to the DeviceNet communication link.

Class Attributes

#	Attribute name	Services	Description	Data type
1	Revision	Get	Revision of the DeviceNet Object Class Definition upon which the implementation is based	Array of UINT8

Instance Attributes

#	Attribute name	Services	Description	Data type
1	MAC ID	Get, Set	Node address	UINT8
2	Baud Rate	Get, Set	The baud rate of the device	UINT8
5	Allocation information	Get, Set	Allocation Choice Master's Mac ID	Struct UINT8 UINT8

The Allocation Information attribute consists of the following:

Allocation Choice Byte
The Allocation Choice byte indicates which of the Predefined Master/Slave Connections are active (in the Configuring, or Established state).

The Allocation Choice byte is initialized to 00 at device power-up or reset.

Master’s MAC ID
The range of values is 0…63 and 255 decimal. A value in the range of 0…63 indicates that the Predefined Master/Slave Connection Set is currently allocated, and denotes the MAC ID of the device that performed the allocation. The value 255 means the Predefined Master/Slave Connection set has not been allocated. The Master’s MAC ID attribute is initialized to 255 (FF hex) at device power-up/reset.

Connection Object, Class 05h

The Connection Class allocates and manages the internal resources associated with both I/O and Explicit Messaging Connections. The specific instance generated by the Connection Class is referred to as Connection Instance or Connection Object.

Table 16. Connection Object States

State	Description	State	Description
00	Non-Existent	03	Established
01	Configuring	04	Timed Out
02	Waiting for Connection ID	05	Deferred Delete

Class Attributes

#	Attribute name	Services	Description	Data type
1	Revision	Get	Revision of the DeviceNet Object	Array of UINT8

Instance Attributes

Instance number	Description
1	Explicit Messaging Connection
2	Polled I/O Connection
4	Change-of-State/Cyclic I/O Connection

#	Attribute name	Services	Description	Data type
1	State	Get	State of the object. (See Table 16.)	UINT8
2	Instance Type	Get	Indicates either I/O (1) or messaging connection (0).	UINT8
3	Transport Class Trigger	Get	Defines the behaviour of the connection.	UINT8
4	Produced Cnxn Id	Get	Placed in CAN Identifier Field when the Connection Transmits	UINT16
5	Consumed Cnxn Id	Get	CAN Identifier Field value that denotes message to be received	UINT16

#	Attribute name	Services	Description	Data type
6	Comm Characteristics	Get	Defines the Message Group(s) across which productions and consumptions are associated in this Connection.	UINT8
7	Produced Connection Size	Get	Maximum number of bytes transmitted across this Connection	UINT16
8	Consumed Connection size	Get	Maximum number of bytes received across this Connection	UINT16
9	Expected Packet Rate	Get, Set	Defines the timing associated with this Connection in milliseconds. A value of 0 deactivates the associated timers.	UINT16
12	Watchdog Timeout Action	Get, Set	Defines how to handle Inactivity/Watchdog timeouts.	UINT8
13	Produced Connection Path Length	Get	Number of bytes in the produced_connection_path length attribute	UINT16
14	Produced Connection Path	Get	Application Object producing data on this Connection	Array of UINT8
15	Consumed Connection Path Length	Get	Number of bytes in the consumed_connection_path length attribute	UINT16
16	Consumed Connection Path	Get	Specifies the Application Object(s) that are to receive the data consumed by this Connection Object.	Array of UINT8
17	Production Inhibit Time	Get	Defines minimum time between new data production in milliseconds.	UINT16

Acknowledge Handler Object, Class 2Bh

The Acknowledge Handler Object is used to manage the reception of message acknowledgements. This object communicates with a message producing Application Object within the device. The Acknowledge Handler Object notifies the producing application of acknowledge reception, acknowledge timeouts and production retry limit.

Class Attributes

#	Attribute name	Services	Description	Data type
1	Revision	Get,	Revision of the DeviceNet Object Class Definition upon which the implementation is based	Array of UINT8

Instance Attributes

#	Attribute name	Services	Description	Data type
1	Acknowledge Timer	Get, Set	Time in milliseconds to wait for acknowledge before resending	UINT16
2	Retry Limit	Get, Set	Number of Acknowledge Timeouts to wait before informing the producing application of a Retry-Limit_Reached event	UINT8
3	COS Producing Connection Instance	Get	Connection Instance Id which contains the path of the producing I/O application object which will be notified of Acknowledge Handler events	UINT16

Motor Data Object, Class 28h

This object serves as a database for motor parameters. Different motor types require different data to describe the motor. For example, AC induction motors do not need field current data like a DC motor to describe the motor.

Motor class	Motor types in class
AC motors	3 - PM synchronous 6 - Wound rotor induction 7 - Squirrel cage induction motor
DC motors	1 - PM DC motor 2 - FC DC motor

Class Attributes

#	Attribute name	Services	Description	Data type
1	Revision	Get	Revision of the DeviceNet Object Class Definition upon which the implementation is based	Array of UINT8

Instance Attributes

#	Attribute name	Services	Description	Motor type	Data type
3	Motor Type	Get	See table above.	AC	UNIT16
6	Rated Current	Get, Set	Rated Stator Current from motor name plate Units: [100mA]	AC/DC	UINT16
7	Rated Voltage	Get, Set	Rated Base Voltage from motor name plate Units: [V]	AC/DC	UINT16
8	Rated Power	Get, Set	Rated Power at Rated Frequency Units: [W]	AC/DC	UINT32
9	Rated Frequency	Get, Set	Rated Electrical Frequency Units: [Hz]	AC	UINT16
12	Pole Count	Get	Number of poles in the motor	AC	UINT16

#	Attribute name	Services	Description	Motor type	Data type
15	Base Speed	Get, Set	Nominal speed at rated frequency from nameplate Units [RPM]	AC/DC	UINT16

Control Supervisor Object, Class 29h

The object models all the management functions for devices within the ‘Hierarchy of Motor Control Devices’. The behaviour of motor control devices is described by the *AC/DC-Drive Object, Class 2Ah* and the *Run/Stop event matrix*. See Table 10 and Figure 12.

Class Attributes

#	Attribute name	Services	Description	Data type
1	Revision	Get	Revision of the DeviceNet Object Class Definition upon which the implementation is based	Array of UINT8

Instance Attributes

#	Attribute name	Services	Description	Data type
3	Run 1	Get, Set	0 = Stop, 1 = Run (See Table 10.)	BOOL
4	Run 2	Get, Set	0 = Stop, 1 = Run (See Table 10.)	BOOL
5	Net Control	Get, Set	0 = Local Control, 1 = Network Control	BOOL
6	State	Get	State of Object. (See Table 11.)	UINT8
7	Running 1	Get	0 = Stopped, 1 = Running	BOOL
8	Running 2	Get	0 = Stopped, 1 = Running	BOOL
9	Ready	Get	1 = Ready, Enabled or Stopping; 0 = Other state	BOOL
10	Faulted	Get	0 = Not faulted, 1 = Fault occurred	BOOL
11	Warning	Get	0 = No Warnings present, 1 = Warning	BOOL
12	FaultRst	Get, Set	0 → 1 Fault Reset	BOOL
13	Fault Code	Get	The fault that caused the last transition to the Faulted state. DRIVECOMM codes are reported. See Drive Manual for further information on DRIVECOMM codes.	UINT16

#	Attribute name	Services	Description	Data type
14	Warning Code	Get	Code word indicating warning present. If multiple warnings are present, the lowest code value is displayed. DRIVECOMM codes are reported. See Drive Manual for further information on DRIVECOMM codes.	UINT16
15	CtlFromNet	Get	0 = NetControl disabled 1 = NetControl enabled	BOOL
16	DNFaultMode	Get, Set	2 = Vendor specified	UINT8
17	ForceFault	Get, Set	0 -> 1 forces the drive to fault	BOOL

AC/DC-Drive Object, Class 2Ah

This object models the functions specific to an AC or DC Drive.

Class Attributes

#	Attribute name	Services	Description	Data type
1	Revision	Get	Revision of the DeviceNet Object Class Definition upon which the implementation is based	Array of UINT8

Instance Attributes

#	Attribute name	Services	Description	Data type
3	At Reference	Get	Frequency arrival	BOOL
4	NetRef	Get, Set	Requests torque or speed reference to be local or from the network. 0 = Set Reference not DN Control 1 = Set Reference at DN Control Note that the actual status of torque or speed reference is reflected in attribute 29, RefFromNet.	BOOL
6	Drive mode	Get, Set	0 = Vendor specific	UINT8
7	Speed Actual	Get	Units = See Table 6.	SINT16
8	SpeedRef	Get, Set	Units = See Table 6.	SINT16
11	Torque Actual	Get	Units = See Table 7.	SINT16
12	TorqueRef	Get, Set	Units = See Table 7.	SINT16
18	AccelTime	Get, Set	Units = milliseconds	UINT16
19	DecelTime	Get, Set	Units = milliseconds	UINT16
22	Speed Scale	Get, Set	Speed scaling factor. See Table 6.	UINT8
24	Torque Scale	Get, Set	Torque scaling factor. See Table 7.	UINT8
29	Ref From Net	Get	Reflecting attribute 4	BOOL

Drive Parameter Object, Class 90h

With the FDNA-01, drive parameters can also be accessed via Explicit Messaging. Explicit Messaging makes use of objects consisting of three parts, *Class, Instance,* and *Attribute.*

Note: When using the Drive Parameter Object to update the fieldbus configuration groups take effect only when the module is powered up the next time or when a ‘Fieldbus Adapter parameter refresh’ is given.

Class is always 144 (90h). *Instance* and *Attribute* correspond to the drive parameter Group and Index in the following way:

- *Instance* = Parameter Group (0…99)
- *Attribute* = Parameter Index (01…99)

For example, Parameter 99.01 is accessed as follows:

- *Class* = 144 = 90h
- *Instance* = 99 = 63h
- *Attribute* = 1 = 01h

Fieldbus Configuration Object 91h

The Fieldbus Configuration Object allows the user to configure the field bus configuration groups without needing to know the drive specific groups associated with the configuration groups.

Note: When using the Fieldbus Configuration Object to update the fieldbus configuration groups, changes to the fieldbus configuration will only take effect when a reset service is requested of the Identity Object, the module is powered up the next time or when a ‘Fieldbus Adapter parameter refresh’ is given.

Class Attributes

#	Attribute name	Services	Description	Data type
1	Revision	Get	Revision of the Configuration Object	Array of UINT8

*Instance #1: FDNA-01 Configuration Parameters Group #1 **

#	Attribute name	Services	Description	Data type
1	Configuration Group #1 - Parameter 1	Get, Set	See Drive configuration	UINT16
2	Configuration Group #1 - Parameter 2	Get, Set	See Drive configuration	UINT16
3	Configuration Group #1 - Parameter 3	Get, Set	See Drive configuration	UINT16
4	Configuration Group #1 - Parameter 4	Get, Set	See Drive configuration	UINT16
5	Configuration Group #1 - Parameter 5	Get, Set	See Drive configuration	UINT16
6	Configuration Group #1 - Parameter 6	Get, Set	See Drive configuration	UINT16
7	Configuration Group #1 - Parameter 7	Get, Set	See Drive configuration	UINT16
8	Configuration Group #1 - Parameter 8	Get, Set	See Drive configuration	UINT16
9	Configuration Group #1 - Parameter 9	Get, Set	See Drive configuration	UINT16
10	Configuration Group #1 - Parameter 10	Get, Set	See Drive configuration	UINT16
11	Configuration Group #1 - Parameter 11	Get, Set	See Drive configuration	UINT16
12	Configuration Group #1 - Parameter 12	Get, Set	See Drive configuration	UINT16
13	Configuration Group #1 - Parameter 13	Get, Set	See Drive configuration	UINT16
14	Configuration Group #1 - Parameter 14	Get, Set	See Drive configuration	UINT16
15	Configuration Group #1 - Parameter 15	Get, Set	See Drive configuration	UINT16
16	Configuration Group #1 - Parameter 16	Get, Set	See Drive configuration	UINT16

#	Attribute name	Services	Description	Data type
17	Configuration Group #1 - Parameter 17	Get, Set	See Drive configuration	UINT16
18	Configuration Group #1 - Parameter 18	Get, Set	See Drive configuration	UINT16
19	Configuration Group #1 - Parameter 19	Get, Set	See Drive configuration	UINT16
20	Configuration Group #1 - Parameter 20	Get, Set	See Drive configuration	UINT16
21	Configuration Group #1 - Parameter 21	Get, Set	See Drive configuration	UINT16
22	Configuration Group #1 - Parameter 22	Get, Set	See Drive configuration	UINT16
23	Configuration Group #1 - Parameter 23	Get, Set	See Drive configuration	UINT16
24	Configuration Group #1 - Parameter 24	Get, Set	See Drive configuration	UINT16
25	Configuration Group #1 - Parameter 25	Get, Set	See Drive configuration	UINT16
26	Configuration Group #1 - Parameter 26	Get, Set	See Drive configuration	UINT16
27	Configuration Group #1 - Parameter 27	Get, Set	See Drive configuration	UINT16

* E.g. in ACS350 and ACSM1 parameter Group 51.

*Instance #2: FDNA-01 Configuration Parameters Group #2 **

#	Attribute name	Services	Description	Data type
1	Configuration Group #2 - Parameter 1	Get, Set	See Drive configuration	UINT16
2	Configuration Group #2 - Parameter 2	Get, Set	See Drive configuration	UINT16
3	Configuration Group #2 - Parameter 3	Get, Set	See Drive configuration	UINT16
4	Configuration Group #2 - Parameter 4	Get, Set	See Drive configuration	UINT16
5	Configuration Group #2 - Parameter 5	Get, Set	See Drive configuration	UINT16
6	Configuration Group #2 - Parameter 6	Get, Set	See Drive configuration	UINT16
7	Configuration Group #2 - Parameter 7	Get, Set	See Drive configuration	UINT16
8	Configuration Group #2 - Parameter 8	Get, Set	See Drive configuration	UINT16
9	Configuration Group #2 - Parameter 9	Get, Set	See Drive configuration	UINT16
10	Configuration Group #2 - Parameter 10	Get, Set	See Drive configuration	UINT16

E.g. in parameter Group 55 in ACS350 or group 53 in ACSM1.

*Instance #3: FDNA-01 Configuration Parameters Group #3 **

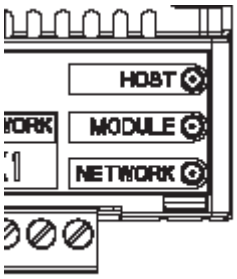
#	Attribute name	Services	Description	Data type
1	Configuration Group #3 - Parameter 1	Get, Set	See Drive configuration	UINT16
2	Configuration Group #3 - Parameter 2	Get, Set	See Drive configuration	UINT16
3	Configuration Group #3 - Parameter 3	Get, Set	See Drive configuration	UINT16
4	Configuration Group #3 - Parameter 4	Get, Set	See Drive configuration	UINT16
5	Configuration Group #3 - Parameter 5	Get, Set	See Drive configuration	UINT16
6	Configuration Group #3 - Parameter 6	Get, Set	See Drive configuration	UINT16
7	Configuration Group #3 - Parameter 7	Get, Set	See Drive configuration	UINT16
8	Configuration Group #3 - Parameter 8	Get, Set	See Drive configuration	UINT16
9	Configuration Group #3 - Parameter 9	Get, Set	See Drive configuration	UINT16
10	Configuration Group #3 - Parameter 10	Get, Set	See Drive configuration	UINT16

* E.g. parameter Group 54 in ACS350 or group 53 in ACSM1.

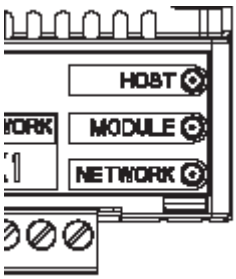
Diagnostics

LED indications

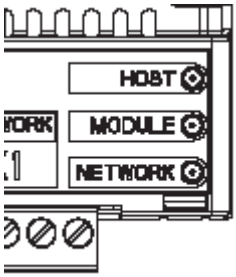
The FDNA-01 module is equipped with three bicolor diagnostic LEDs. The LEDs are described below.



Name	Color	Function/State
HOST	Blinking green	Establishing communication to host.
	Green	Connection to host OK.
	Blinking red	Communication to host lost temporarily.



Name	Color	Function/State
MODULE	Off	There is no power applied to the device.
	Green	The device is operating in a normal condition.
	Flashing green	The device needs commissioning due to configuration missing, incomplete or incorrect. The device may be in the Standby state.
	Flashing red	Recoverable fault.
	Red	The device has an unrecoverable fault. This may be cleared by: a Fieldbus Adapter parameter refresh, cycling DeviceNet network power or cycling drive power. This may have been caused by: a duplicate MAC error, a bus-off condition or buffer overflow.
	Flashing red-green	The device is in Self Test.



Name	Color	Function/State
NETWORK	Off	Device is not on-line. – The device has not completed the Dup_MAC_ID test yet. – The device may not be powered, look at Module Status LED.
	Flashing green	Device is on-line but has not connections in the established state. – The device has passed the Dup_MAC_ID test, is on-line, but has no established connections to other nodes. – For a Group 2 Only device it means that this device is not allocated to a master.
	Green	The device is on-line and has connections in the established state. – For a Group 2 Only device it means that the device is allocated to a master.
	Flashing red	One or more I/O Connections are in the Timed-Out state.
	Red	Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network (Duplicate MAC ID, or Bus-off).

Definitions and abbreviations

Change of State/Cyclic Message

The Change of State/Cyclic Message is transmitted by either the Master or the Slave. A Change of State/Cyclic Message is directed towards a single specific node (point-to-point). An Acknowledge Message may be returned in response to this message.

Communication Module

Communication Module is a name for a device (e.g. a fieldbus adapter) through which the drive is connected to an external serial communication network (e.g. a fieldbus). The communication with the communication module is activated by a drive parameter.

EDS File

The Electronic Data Sheet (EDS) file identifies the properties of the device to the DeviceNet Scanner. Each type of drive and application program requires its own EDS file.

Input

In the ODVA DeviceNet specification the word ‘input’ is used to describe data flow from a device (such as the FDNA-01) to the network.

I/O Assembly selection

Smart networked devices (like the FDNA-01) can produce and/or consume more than one I/O value. Typically, they will produce and/or consume one or more I/O value, as well as status and diagnostic information. Each piece of data communicated by a device is represented by an attribute of one of the device’s internal objects.

Communicating multiple pieces of data (attributes) across a single I/O connection requires that the attributes be grouped or assembled together into a single block.

MAC ID

Every node on DeviceNet network has to have a unique identifier. This node number is called MAC ID (Media Access Control ID).

FDNA-01 DeviceNet Adapter module

The FDNA-01 Adapter module is one of the optional fieldbus adapter modules available for ABB drives. The FDNA-01 is a device through which an ABB drive is connected to a DeviceNet serial communication bus.

ODVA

ODVA stands for Open DeviceNet Vendor Association. ODVA is an independent organization that promotes interoperativity between different manufacturers DeviceNet products. ABB is an Associate Member at the ODVA.

Output

In the ODVA DeviceNet specification the word ‘output’ is used to describe data flow from the network into a device (such as the FDNA-01).

Parameter

A parameter is an operating instruction for the drive. Parameters can be read and programmed using the drive control panel, or through the FDNA-01 module.

Poll Message

Most DeviceNet Scanners as well as the FDNA-01 support two different data services. These are Poll and Change of State/Cyclic messages.

The Poll Command is an I/O Message that is transmitted by the Master. A Poll Command is directed towards a single, specific Slave (point-to-point, FDNA-01 always acts as a Slave). A Master must transmit a separate Poll Command Message for each of its Slaves that is to be polled. The Poll Response is an I/O Message that a Slave transmits back to the Master when the Poll Command is received.

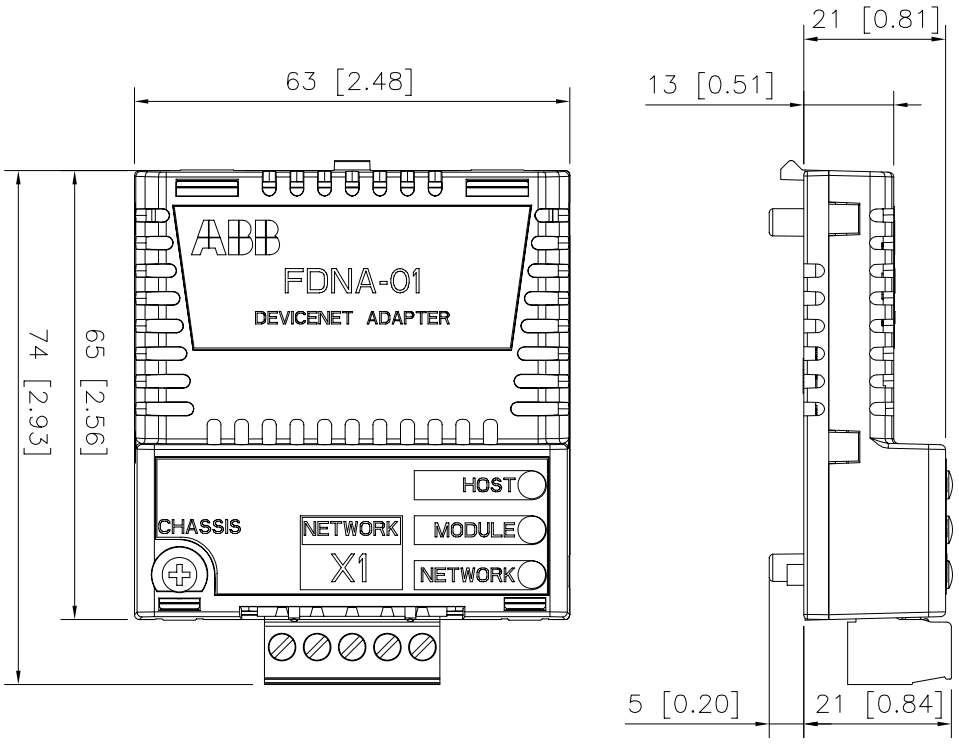
Scanlist

The DeviceNet Scanner communicates with the DeviceNet Slaves in a user-defined order. This order of communication is the scanlist. The scanlist contains a complete list of the Slave nodes and the order in which the Slaves are accessed.

Technical data

FDNA-01

Enclosure:



Mounting: Into the option slot on the drive.

Degree of protection: IP20

Ambient conditions: The applicable ambient conditions specified for the drive in its manuals are in effect.

Indicators: Three bicolor LEDs (HOST, MODULE, NETWORK)

Connectors:

- 20-pin connector to drive
- Removable 5-pole screw type connector for bus connection (max. 2.5 mm^2 cross section)

Power supply:

Input voltage

- From Drive: +3,3V DC (+/- 5%)
- From Network: +24V DC nominal (+11V to +30V)

Input Current

- From Drive: 180 mA typical, 300 mA maximum (+3.3V)
- From Network: 20 mA typical, 50 mA maximum (+24V)

General:

- Estimated min. lifetime: 100 000 h
- All materials UL/CSA-approved
- Complies with EMC standards EN 50081-2 and EN 50082-2
- Bus interface functionally isolated from drive

Fieldbus link

Compatible Devices: Any ODVA-compliant DeviceNet scanner supporting Poll - Response commands to Group 2 only Slaves

Medium:

- **Termination:** 121 Ω, 1%, Metal Film, 1/4 W
- **DeviceNet Cables:**
  YR-29790 (Thick DeviceNet Cable)
  YR-29832 (Thin DeviceNet Cable)
- **Maximum Bus Length:** 1200 m

Topology: Multi-drop

Serial Communication Type: Asynchronous, half Duplex

Transfer Rate: 125, 250 or 500 kBit/s

Protocol: DeviceNet

Appendix - Varying Number of Drive Parameters

Assembly object instances can either be dynamic or static. The FDNA-01 only supports static assembly objects. For each supported assembly, the member list (and implicitly the length in bytes) has been fixed either by the ODVA AC/DC Drive Profiles or ABB.

FDNA-01 assemblies that include “plus Drive Parameters" have ten members each reserved for the output or input of drive parameters. In some cases, it may be desirable for these assemblies to have fewer drive parameter members. The FDNA-01 provides the flexibility to accomplish this.

However, this behaviour is non-standard and usually requires additional configuration of the DeviceNet Master as well. In particular the length in bytes of the assembly must be changed to match the drive configuration. This can usually be accomplished by editing the EDS file for the drive or via manual configuration of the DeviceNet Master. A description of how to change the EDS file is provided below. For manual configuration, see the documentation for the DeviceNet Master.

Note: Only one EDS file with the same Product ID can be installed at a time. Changing the EDS file changes it for all drives with that Product ID. In situations where it is necessary to have different sizes of the same assembly on devices with the same Product ID, manual configuration is required.

The number of drive parameters may be configured between one and ten for output and input by changing the configuration value of "Number of Output Drive Parameters" or "Number of Input Drive Parameters" respectively. To use zero drive parameters, use the assembly upon which the "plus Drive Parameters" assembly is based.

To change the EDS file, copy it to a new file name and open the copy with a text editor. Search for the [IO_Info] section of the file for the appropriate assembly. For example the entry for the Basic Speed Control Input plus Drive Parameters is below.

```
Input7=
        24, 0, 0x0005,
        "Basic Speed Control Input + Drive Parameters",
        7, "20 04 24 AA 30 03",
        "Basic Speed Control Input + Drive Parameters";
```

Length in bytes

The length in bytes needs to be updated to match the value from the table below. If more than one assembly "plus Drive Parameters" is being used, both assembly entries in the file must be changed. Save the file. Use the new EDS file to configure the DeviceNet Master.

Length in Bytes of Assemblies with Drive Parameters

	Number of Drive Parameters									
Assembly	1	2	3	4	5	6	7	8	9	10
120	6	8	10	12	14	16	18	20	22	24
121	6	8	10	12	14	16	18	20	22	24
122	8	10	12	14	16	18	20	22	24	26
123	8	10	12	14	16	18	20	22	24	26
170	6	8	10	12	14	16	18	20	22	24
171	6	8	10	12	14	16	18	20	22	24
172	8	10	12	14	16	18	20	22	24	26
173	8	10	12	14	16	18	20	22	24	26
901	6	8	10	12	14	16	18	20	22	24
902	8	10	12	14	16	18	20	22	24	26
951	6	8	10	12	14	16	18	20	22	24
952	8	10	12	14	16	18	20	22	24	26
961	6	8	10	12	14	16	18	20	22	24
962	8	10	12	14	16	18	20	22	24	26
971	10	12	14	16	18	20	22	24	26	28
972	14	16	18	20	22	24	26	28	30	32

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